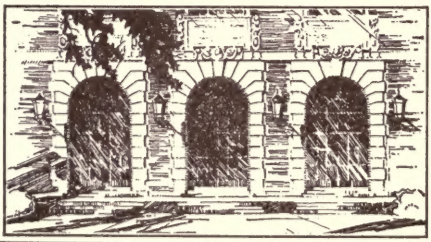
LIBRARY OF THE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

557
I l6e
v.2
cop.2



ILLINOIS HISTORICAL SURVEY

ECONOMICAL

GEOLOGY OF ILLINOIS.

REPRINTED FROM THE ORIGINAL REPORTS OF THE GEOLOGICAL SURVEY, WITH ADDITIONS AND EMENDATIONS.

BY

A. H. WORTHEN.

STATE GEOLOGIST.

VOLUME 2.

PUBLISHED BY AUTHORITY OF THE LEGISLATURE OF ILLINOIS.

1882.

H. W. ROKKER, STATE PRINTER AND BINDER,
SPRINGFIELD, ILL.:

IP62
v. 2
copy 2

4766

TABLE OF CONTENTS.

CHAPTER I.

GEOLOGY OF PERRY COUNTY. Pages.

By A. H. Worthen 1-23

CHAPTER II.

GEOLOGY OF JERSEY COUNTY.

By A. H. Worthen 24-44

CHAPTER III.

GEOLOGY OF GREENE COUNTY.

By A. H. Worthen 45-58

CHAPTER IV.

GEOLOGY OF SCOTT COUNTY.

By A. H. Worthen 59-71

CHAPTER V.

GEOLOGY OF WASHINGTON COUNTY.

By Henry Engelmann 72-102

CHAPTER VI.

GEOLOGY OF CLINTON COUNTY.

By Henry Engelmann 103-125

CHAPTER VII.

GEOLOGY OF MARION COUNTY.

By Henry Engelmann 126-156

27020

CHAPTER VIII.

GEOLOGY OF JEFFERSON COUNTY. Pages.

By Henry Engelmann 157-179

CHAPTER IX.

GEOLOGY OF COOK COUNTY.

By H. M. Bannister 180-201

CHAPTER X.

GEOLOGY OF LA SALLE COUNTY.

By H. C. Freeman 202-236

CHAPTER XI.

GEOLOGY OF CALHOUN COUNTY.

By A. H. Worthen 237-262

CHAPTER XII.

GEOLOGY OF PIKE COUNTY.

By A. H. Worthen 263-283

CHAPTER XIII.

GEOLOGY OF ADAMS COUNTY.

By A. H. Worthen 284-305

CHAPTER XIV.

GEOLOGY OF BROWN COUNTY.

By A. H. Worthen 306-319

CHAPTER XV.

GEOLOGY OF SCHUYLER COUNTY.

By A. H. Worthen 320-336

CHAPTER XVI.

GEOLOGY OF FULTON COUNTY.

By A. H. Worthen 337-360

CHAPTER XVII.

GEOLOGY OF DE KALB, KANE AND DU PAGE COUNTIES. Pages.

By H. M. Bannister 361-377

CHAPTER XVIII.

GEOLOGY OF MC HENRY AND LAKE COUNTIES.

By H. M. Bannister 378-388

CHAPTER XIX.

GEOLOGY OF KENDALL COUNTY.

By H. M. Bannister 389-403

CHAPTER XX.

GEOLOGY OF MORGAN COUNTY.

By H. M. Bannister 404-419

CHAPTER XXI.

GEOLOGY OF CASS AND MENARD COUNTIES.

By H. M. Bannister 420-434

CHAPTER XXII.

GEOLOGY OF TAZEWELL, MC LEAN, LOGAN AND MASON COUNTIES.

By H. M. Bannister 435-449

CHAPTER XXIII.

GEOLOGY OF GRUNDY COUNTY.

By Frank H. Bradley 450-467

CHAPTER XXIV.

GEOLOGY OF WILL COUNTY.

By Frank H. Bradley 468-488

CHAPTER XXV.

GEOLOGY OF KANKAKEE AND IROQUOIS COUNTIES.

By Frank H. Bradley 489-504

CHAPTER XXVI.

GEOLOGY OF VERMILION COUNTY. Pages.

By Frank H. Bradley 505-532

CHAPTER XXVII.

GEOLOGY OF CHAMPAIGN, FORD AND EDGAR COUNTIES.

By Frank H. Bradley 533-542

CHAPTER XXVIII.

GEOLOGY OF HENDERSON COUNTY.

By H. A. Green 543-556

CHAPTER XXIX.

GEOLOGY OF WARREN COUNTY.

By H. A. Green 557-570

CHAPTER XXX.

GEOLOGY OF MERCER COUNTY.

By H. A. Green 571-583

CHAPTER XXXI.

GEOLOGY OF KNOX COUNTY.

By H. A. Green 584-596

CHAPTER XXXII.

GE LOGY OF STARK COUNTY.

By H. A. Green 597-605

CHAPTER XXXIII.

GEOLOGY OF WOODFORD COUNTY.

By H. A. Green 606-615

CHAPTER I.

PERRY COUNTY.

Perry county lies immediately north of Jackson, which forms its southern boundary, and is bounded on the west by Randolph, on the north by Washington, and on the east by Franklin and Jefferson counties. It embraces a superficial area of twelve townships, or 432 square miles, about three-fourths of which was originally covered with timber. The principal streams within its limits are Little Muddy, Beaucoup and Columbo creeks, all of them the northwestern affluents of the Big Muddy river. The surface of the country is generally rolling, and on some of the streams becomes considerably broken by low ridges, but not sufficiently abrupt to render the land unfit for cultivation; while some portions are quite level, including some flat prairies and a portion of the timbered land known as "post-oak flats." The Beaucoup traverses the county from north to south, nearly through its center, and the prairies occupy mainly the highlands between this stream and the Little Muddy on the east, and Columbo on the west, except the "Grand Coti prairie," which occupies an elevated ridge in the northwestern part of the county. The prairies here, as is usually the case in other portions of the State, occupy the highest ground, but their relative elevation is quite variable, even in a single county. In this county they are mostly surrounded by timbered flats, which gradually pass into more broken timbered lands as we approach the streams. Their surface is generally flat, or gently rolling, passing locally into the broken grassy upland known as "barrens."

The geological formations of this county are restricted to the Coal Measures and the superficial deposits known as drift. The Coal Measure strata that formed the original surface in this region,

before the drift was deposited upon them, consist mainly of arenaceous, argillaceous and bituminous shales, fine-grained sandstones, and thin beds of siliceous and argillaceous limestone, and these rocks seem to have furnished a large part of the material of which the drift is composed. Hence the soil and sub-soil of this region is arenaceous, with a smaller admixture of clay, and the material exists in a high state of comminution, a part of it, at least, being reduced to an almost impalpable powder. This physical condition produces certain characters in the soil, which might be supposed to belong only to a stiff clay. When quite dry it rapidly absorbs water, but after having been moist for some time it becomes almost impermeable, the minute particles of the mass filling all the pores between the larger grains, and closing them so effectually that water is prevented from passing through, and remains upon the surface until it is evaporated. If this soil is mechanically worked when thus saturated, it becomes exceedingly tenaceous in consequence of the adhesive power of the minute particles of which it is in part composed, and appears to be far more clayey than it really is. Generally it crumbles readily when dry, and then shows its sandy character. It is not retentive of moisture, but in a dry atmosphere it readily gives off the water it has absorbed, and re-absorbs the moisture of the atmosphere more slowly and in less quantity than a clay soil does. Occasionally the sub-stratum is found to be a stiff, rough clay, and at other points, sand. In digging wells on the prairie lands, water is frequently found at a depth of ten feet, and is seldom deeper than thirty feet, and is usually obtained in the drift deposits before reaching the stratified rocks.

The "post-oak flats" are nearly level stretches of upland, which are very sparsely timbered with post oak (*Quercus obtusiloba*) of sturdy growth, standing far apart, and interspersed with black-jack (*Quercus nigra*), and young post oak. They form an open forest, and the nearly white soil is but scantily covered with vegetation. The sub-soil is the finely-comminuted white sandy loam, already described as forming the soil of the adjacent prairies, and reaches to the depth of several feet. The upper soil is quite shallow, and seems to be distinguished from the sub-soil only by a slight admixture of vegetable mould. This soil, like that of the prairies, is so finely comminuted as to render it almost entirely impermeable to water, which stands in the depressions upon the surface until it slowly disappears by evaporation. At such localities we find pin oak, scaly-bark hickory, and sometimes laurel oak, associated with the post oak and black-jack. These "flats" extend around the

prairies, forming a narrow belt between them and the more broken timbered lands adjacent, and also form the highest portions of the broad flat ridges between the streams where no prairies occur. The principal difference between the prairie soil and that of the "flats" consists in the former being more charged with vegetable humus, and being also somewhat deeper than it is upon the "flats."

The "barrens," as that term is understood in this region, consist of low hills and ridges, covered with a dense growth of tall grasses, and quite destitute of timber, or with only a few scattering trees. The sub-soil on these "barrens" is similar to that above described, and consists of the same white sandy loam, but their surface configuration affords a complete drainage, and they have therefore sustained a better growth of vegetation, which has formed a few inches of good soil, highly charged with humus. The "barrens" become dry early in the spring, from their better surface drainage, and resist the drouth better than the "flats," because the soil is more porous, and absorbs more moisture from the atmosphere. The absence of timber on them appears to be due to the annual fires that sweep over them, fed by the tall grasses that cover the surface, a conclusion that is sustained by the fact that as the country is settled, and the fires are kept out, a vigorous growth of young trees soon covers the surface. The "barrens" merge into the post oak hills, which are similar ridges, covered with a heavy growth of timber, consisting in part of post oak, with black oak, black-jack, hickory, etc. The white oak is confined mainly to the breaks of the streams.

The principal creek bottoms within the barren region have a soil very similar to that of the flats, but a little coarser, and containing a greater per cent. of vegetable mould, rendering them as dark colored as the prairie soils. The timber is very tall and heavy, and consists principally of the swamp white oak, pin oak, bur oak, red oak, laurel oak, scaly-bark hickory, ash, black walnut, hazel, etc.

The character of the upland country above described does not extend very far to the southward beyond the limits of this county, but it includes a limited area in the northeastern part of Jackson county, and from thence extends southeastward into Franklin and Williamson counties.

Of all these varieties of soil, the "flats" are the most unproductive, and will require the greatest amount of labor and skill to bring them up to the highest standard of a good productive soil. This can be done most effectually and cheaply by deep and frequent plowing, which loosens the soil and assists the surface drainage, and

by manuring and plowing under green crops to give the required amount of vegetable mould, and this treatment would probably insure a steady increase in the productive capacities of the soil, until it equaled or perhaps exceeded that of the adjacent prairies.

The drift deposits of this section of the State are comparatively thin, seldom attaining a thickness of more than thirty or forty feet, and our knowledge of their general characters has been derived from the examinations of wells that have been sunk in various parts of the county for water, and from cuts along the Illinois Central railroad. Here, as elsewhere over the central and southern portions of the State, they consist of beds of clay, sand and gravel, partially stratified, and varying both in depth and arrangement of materials at almost every point where they are penetrated. A well sunk on the northwest quarter of section 16, township 6 south, range 4 west, gave the following section:

Soil and sub-soil	3 feet
Reddish clay	14 "
Sand and gravel	2 " 6 inches
Yellow, tough clay	10 " 6 "

This section will give an idea of the general character of these deposits, although probably no two wells would afford exactly the same section. Below these beds we find at some localities the same "blue mud"* already alluded to in the foregoing chapter, as occurring in a similar position in Jackson county, while at others, wells are sunk to the stratified rocks of the Coal Measures without meeting with it. Hence we may infer that it was either a local deposit that accumulated only in ponds or sloughs, or else it was in part swept away by surface erosion at the commencement of the drift period. Its average thickness cannot be definitely stated, for when it was found in digging for water, the well was generally abandoned as soon as this deposit was reached, because the partly decomposed vegetable matter which it contains rendered the water unfit for use. It appears to be composed, in good part, of vegetable matter, consisting of leaves and partially decayed wood, embedded in a muddy sediment, and has been penetrated at some places to the depth of five to ten feet. It has been found at the following points in this county: At Crawford's mill, on Pipe-stone creek, on section 33, township 6 south, range 3 west; at Mr. Andrew Brown's, on the western edge of Six-mile prairie; at Old DuQuoin, on section 26,

NOTE.—*In the Geological Reports of Ohio, Dr. NEWBERRY recognizes a similar deposit in that State, to which he has given the very significant name of "Forest Bed," from the abundance of vegetable remains usually found in it.

township 6 south, range 1 west, and at a saw mill on a branch of Swanwick creek, on section 15, township 4 south, range 3 west. It usually lies at the bottom of the drift deposits, but at one point in Jackson county it was underlaid by a bed of sand two or three feet in thickness. This sand, as well as the blue mud above it, probably belongs to a period somewhat older than the true drift deposits, and it is very important that wherever these beds are penetrated in sinking wells, or are otherwise exposed, a careful examination should be made for any organic remains that they may contain, as these would no doubt throw some light upon their true origin, and the conditions under which they have been deposited.

Coal Measures.

All the stratified rocks that outcrop at the surface in this county belong to that division of the Carboniferous system usually known as Coal Measures; so called because they contain all the coal seams of any practical value that are found in the rocks of this age. They embrace an aggregate thickness of nearly three hundred feet, and consist mainly of soft sandstones and shales, thin beds of limestone, bituminous slates and coal, and include the horizon of two of the principal coal seams at present known in the Illinois coal fields. These coals are associated with the only limestones of any importance that are found in the county, and consequently their outcrop is more readily defined and more easily traced than that of the soft shales and sandstones that form the upper two hundred feet of the section. The principal outcrops of these limestones, and the beds associated with them, are along the southern and eastern borders of the county, and they dip gently to the northeastward, at the rate of about eight to ten feet per mile, so that the beds which outcrop along the streams in the southern part of the county are two hundred feet or more below the surface in the northern part. This has been fully determined by the various coal shafts sunk along the line of the Illinois Central railroad, in this county, and from these we have been enabled to obtain a very complete section of all the beds which outcrop in this county above the DuQuoin coal. This coal is probably the equivalent of No. 5 of the general section, (see chapter 6, Vol. 1, p. 166,) but this is a point we have not yet been able to determine positively. This coal, No. 5, and that above it, No. 6, have so many features in common, that, where but one is developed, it is frequently difficult to say to which horizon it belongs. But, from the best evidence we have been able to obtain, we are inclined to

the opinion that the DuQuoin coal should be referred to No. 5, and the small seam above, which ranges in thickness in this county from a few inches to three feet, is really the equivalent of No. 6, or the Belleville coal. The following section gives the relative position and thickness of the beds outcropping in this county. The data for the upper portion of this section was obtained from the shafts of Coloma and Tamaroa:

Soft micaceous sandstone	15 feet	
Sandy shale	20 "	
Massive, hard, ferruginous sandstone	10 "	
Blue clay shale	20 "	
Impure iron ore, with fossil shells	2 "	
Bituminous shale	3 "	
Coal No. 8	0 "	9 inches
Fire-clay	3 "	
Sandstone	15 "	
Sandy shale, with some kidney-ore in the lower part	102 "	
Hard calcareous sandstone	3 "	
Black carbonaceous slate, passing into coal No. 7	1 "	6 inches
Clay shale	3 "	
Hard, arenaceous, slaty rock	16 "	
Clay shale	7 "	
Light-gray, hard, sub-crystalline limestone	7 to 9 "	
Bituminous shale	1 to 2 "	
Coal, sometimes wanting—No. 6 ?	1 to 3 "	
Fire-clay or clay shale	3 to 4 "	
Limestone, light colored and arenaceous	7 "	
Gray shale	6 "	
Limestone	6 "	
Shales, with fossil plants	15 to 25 "	
Coal No. 5 ?	5 to 7 "	
Clay shale, with nodules of hard limestone	15 "	
	305 feet 3 inches	

Below the beds represented in the above section there are still at least two hundred feet of strata belonging to the Coal Measures, and containing three or four coal beds in Jackson county, as well as in Northern and Central Illinois, that range from two to five feet in thickness; all of which probably underlie the entire area of this county, and crop out in the adjoining counties to the south and southeast, while to the west they thin out to less than a hundred feet in thickness, and contain little or no coal of any practical value. All the coals described in the foregoing chapter, as outcropping in Jackson county, underlie those represented in the foregoing section; but they may not be developed in this county so as to be of economical importance.

The coal ("No. 6 ?") in this section outcrops on the western borders of the county, on the eastern edge of Six-mile prairie, with a thickness of three feet, and two miles farther north there is another

outcrop, apparently of the same seam, where the coal is only eighteen inches in thickness. In the vicinity of DuQuoin this upper coal has been found at many points, ranging in thickness from two feet down to a mere streak of coaly matter.

At the Black Diamond mine, north of St. Johns, the coal shaft was sunk through the following beds:

Clay (surface material)	24 feet
Limestone	9 "
Soap-stone (clay shale)	1 "
Bituminous shale	1 "
Coal	1 "
Fire-clay	4 "
Limestone	6 "
Clay shale	5 "
Limestone	7 "
Blue clay shale	15 "
Hard, dark-colored rock (limestone?)	3 "
Bituminous shale	2 "
Coal	5 "
	93 feet

The Eagle shaft, between the Black Diamond and St. Johns, commences at a level below the upper seam, and the shaft passed through the following beds:

Drift clay	10 feet
Soft fire-clay	6 "
Shales	15 "
Limestone	6 "
Shales	10 "
Coal	6 "

Three-quarters of a mile east of the Black Diamond shaft the little coal seam is exposed on Reese's creek, below a compact, gray limestone. The coal is here about twenty inches thick. Farther down on this creek, and nearly east of St. Johns, we find another outcrop of apparently this same coal, where it is considerably thicker, and was worked by drifting at an early day; but the coal appears to have been rather poor in quality, and the work was soon abandoned. At Mr. Archie Wilson's place, five miles southeast of DuQuoin, the limestone forming the roof of the coal outcrops on a small creek near his dwelling, and has been burned for lime. The coal, which is here two feet thick, has been mined by stripping in the creek bottom, and, judging from the small fragments left upon the surface, where it had been deposited, as it was taken out of the mine, it appeared to be of good quality.

At Pinckneyville, the limestone overlying the small coal was found twenty feet below the surface, on the public square, and was pene-

trated to the depth of five feet without reaching the bottom. At Owen's coal shaft, adjoining the town, the following beds were passed through:

Soil, yellow clay, etc. (Drift)	16 feet	
Quick-sand	1 "	
Light gray limestone, underlaid by a faint streak of coal	1 "	
Argillaceous shale	14 "	
Compact blue limestone	6 "	
Bituminous shale	0 "	10 inches
Coal	6 "	
Clay shale, with calcareous nodules	5 "	
	49 feet	10 inches

This is probably the DuQuoin coal, and it outcrops and has been worked on a ravine southeast of the town, in section 30, township 5 south, range 2 west. A half mile northeast of town, the coal crops out on the Beaucoup; and several shafts have been sunk to the coal at this point. The bituminous shale, overlying the coal, is here several feet in thickness, and is overlaid, as above, by the blue limestone, which, a little higher up, forms a shoal across the bed of the creek. There seems to be an undulation in the strata here, which brings the main coal above the creek level, just at the town, while it dips below that level above and below. On Beaucoup creek, below Pinckneyville, but few outcrops are found, but enough to show that the coal extends nearly or quite to the county line of Jackson county; and it is quite possible that the coal noticed in the report on that county, as outcropping near the north line of the county, will prove to be the DuQuoin coal.

Near the north line of section 6, township 6 south, range 2 west, the following beds may be seen, outcropping below the drift clays:

Calcareous shale	1 foot	
Blue limestone	2 to 4 feet	
Bituminous shale	0 "	5 inches
Coal	6 "	
Clay shale	5 "	

Coal has been found in various localities in this neighborhood, in sinking wells, and the overlying limestones and shales outcrop at various points. At the Creek Pond bridge, on the southwest quarter of section 29, the coal crops out in the bank of the Beaucoup, and is overlaid by three feet of bituminous shale. The coal is reported to be from six to seven feet thick at this locality. From Pinckneyville southward, along Beaucoup creek, the coal varies but little from the level of the creek, and may be mined almost anywhere within thirty or forty feet of the general surface level.

In the region west of the Beaucoup, and extending to the west line of the county, very few outcrops of rocks of any kind are to be seen, as there are no streams that cut through the superficial clays to the stratified rocks below; but the coal and the overlying limestone and shale have been found at many points in sinking wells, and they underlie the surface, generally, except where they have been removed by the erosion of the valleys. Southwest of Pinckneyville, on the Little Columbo creek, and at various points in township 6 south, range 3 west, the limestones have been found at a moderate depth below the surface, in sinking wells. On sections 14 and 15, the limestone was found about 15 feet below the surface; and, in the east part of section 9, it outcrops in the banks of the creek, and continues to outcrop, as we ascend the creek, for half a mile or more. On the lower course of the creek it was not met with. Farther west, on a branch in section 4, and in a ravine on the prairie in the south part of section 3, and the north part of section 10, outcrops of the limestone were seen; and, on section 4, it forms the bed of the creek, and is overlaid by from six to twelve inches of argillaceous shale, and about six inches of coal, probably representing the three-foot coal in the section already given on a preceding page; and this is overlaid by several feet of argillaceous shale, which appears to be fine enough for the manufacture of firebrick. Higher up the creek, there are some outcrops of shaly, micaceous sandstone, which occupy a horizon above the limestones associated with the coal seams, and may be regarded as belonging to the Upper Coal Measures.

On the main Columbo creek, there are no exposures on its lower course in this county, and it is bordered by wide stretches of low bottom land. The first outcrop of the limestone on this creek is on section 18, township 6 south, range 3 west; and they again appear on section 12. The shaly limestone and calcareous shales at the Slate ford, on the southwest quarter of section 1, and at the ford on the northwest quarter of section 2, also belong to this limestone series, and are overlaid by heavy masses of tumbling limestone, from three to six feet thick, that probably belong to the bed above the little coal. These outcrops afford a sure indication of the presence of the main coal, over this portion of the county, at a very moderate depth below the surface. On the northeast quarter of section 3, township 6 south, range 4 west, a seam of coal, capped by a little blue shale, has been discovered underneath an outcrop of limestone, which appears here in two beds, each about eight feet thick. The coal is reported to be about three feet thick, and prob-

ably holds the same position as the thin streak of coal at Pinckneyville, and the little seam near St. Johns. The same coal crops out about one mile northeast of this point, on the southwest quarter of section 34, township 5 south, range 4 west, and is overlaid by the same beds as at the former locality. The coal was reported to be three feet thick here, and was used for burning lime from the overlying limestone. On section 28 there is another outcrop of the same coal. It is here only eighteen inches thick, and is overlaid by bituminous shale and limestone, as at the other localities. It is underlaid by fire-clay, or clay shale, twenty inches thick, and by limestone similar in character to that above it.

At James McMillan's, on the northeast quarter of section 10, township 6 south, range 4 west, coal was found in his well, two feet in thickness, between two beds of clay shale, the overlying limestone having been removed by denudation. In township 5 south, range 4 west, the limestone above this thin coal is exposed in a ravine, on section 32, and was struck in a well, at the foot of the mound near the south line of section 32, at a depth of from twelve to fifteen feet below the surface. There are two of these *mounds* in this vicinity, and they rise out of the surrounding prairie to the height of sixty to eighty feet, like islands from the sea. They appear to have been formed by the irregular erosion of the surface, anterior to, or during the Drift period, and are formed mainly of sandstones, shales, etc., that belong to a horizon above the limestones that are associated with the main coal seams in this county. One of them is covered with timber, but the other has several farms upon it, and, from the wells and cisterns that have been dug, the following section of its strata has been compiled:

Soil and clay, forming the summit	7 feet.	
Soft sandstone and shales	42 "	
Coal	1 "	6 inches.
Argillaceous shale, passing into sandy shale	9 "	6 "
Ferruginous sandstones, in thin layers	2 "	
Sandstone and shale, at least ten feet, perhaps more	10 "	
Compact light gray limestone, not passed through	? "	

On Pipe-stone creek, a mile south of Denmark, the limestone and shale of the lower coal are exposed. At Mr. Ayers', near the bridge, on section 16, two wells were dug; and the main coal was found at a depth of thirty-eight feet.

At Mr. S. Holliday's, on the southern border of Grand-Coti prairie, a well was sunk, passing through the following strata:

Soil and tough red clay	19 feet.
Shaly sandstone, passing into argillaceous shales, with concretions of iron ore	32 "
Blue shale	3 "
Coal	1 " 6 inches.

This coal is probably the same as that passed through on the mound, and lies above all the limestones associated with the DuQuoin coal, and is probably No. 7 of the general section. These beds underlie all the northern portion of the county, and, having a slight general dip to the northeastward, are far below the surface at the northern line of the county, and are succeeded by higher beds of sandstone and shale. These barren measures cover all the northern portion of the county, to depths ranging from one hundred to two hundred feet, and must be passed through before any workable coal can be reached. The sandstones and shales outcrop on all the streams in the northern part of the county; and some of the beds are sufficiently hard to withstand surface exposure, and form low cliffs of sandstone on some of the small streams.

Returning to the southeastern part of the county, we find coal on the bank of Span's creek, close to the county line; but, as it was not opened when we visited the locality, its thickness can not be definitely stated. It is variously reported at from two and a half to four feet. Partial outcrops of sandstone and siliceous limestone were observed in connection with this coal, and apparently overlying it. It is probably the same as that found at Archie Wilson's place, five miles southeast of DuQuoin, and most probably represents the three-foot coal in the general section of the Coal Measures of this county. At Wilson's, the coal is but two feet thick; and the rocks associated with it give the following section:

Light gray or brownish-gray massive limestone	6 feet.
Irregularly-bedded bluish-gray limestone	2 "
Clay shale	1 "
Coal	2 "
Clay shale	1 "
Sandy shale, passing into sandstone	? "

The limestone above this coal appears to be identical with the upper bed in the Pinckneyville section, and the coal the same as that on Span's creek, and the two-foot coal in the Black Diamond shaft. The limestone is hard, compact, somewhat brittle, and hard to burn, but makes a strong, though somewhat dark-colored lime. In the bottom on Six-mile creek, near the county line, in Jackson county, limestone has been struck in a well, thirty feet below the surface, which is probably the limestone immediately above the DuQuoin coal. The following sections of the shafts at DuQuoin and St.

Johns are given to illustrate the variations that occur in the beds associated with the DuQuoin coal, and the unevenness of the surface before the drift was deposited, as is shown by the variable thickness of these deposits on what is now a nearly level surface:

SHAFT AT ST. JOHNS.

Soil and drift clays	43	feet.		
Gray and compact limestone	3	"	6	inches.
Indurated clay shale	4	"	6	"
Compact gray limestone	2	"	6	"
Bituminous shale	5	"	6	"
Arenaceous and argillaceous shales	16	"		
Coal	6	"	4	"
Clay shale, with iron pyrites	4	"		
	85	feet	4	inches.

DUQUOIN CENTRAL MINE.

Soil and drift clay	29	feet.		
Blue clay shale	8	"		
Compact gray limestone	5	"	8	inches.
Dark blue shale	5	"	6	"
Coal	6	"		
Clay shale, with iron pyrites	2	"	6	"
Compact nodular limestone, embedded in clay shale	5	"		
	62	feet	8	inches.

MILL SHAFT—DUQUOIN.

Soil and drift clays	32	feet	5	inches.
Hard gray limestone	7	"	1	"
Argillaceous shale	8	"	11	"
Black limestone	0	"	9	"
Shales—argillaceous	17	"	7	"
Coal	6	"	6	"
	73	feet	3	inches.

DUQUOIN MINE.

Soil and drift clay	40	feet.		
Argillaceous shale	20	"		
Coal	6	"	7	inches.
Clay shale	1	"	3	"
Nodular gray limestone, embedded in shale	4	"		
Argillaceous shale	2	"	6	"
Limestone	0	"	10	"
Argillaceous shale	3	"	6	"
	78	feet	8	inches.

WALL'S COLLIERY.

Soil and drift clay	19	feet.	
Gravel and water-worn limestone	1	"	
Gray limestone, with clay partings	6	"	
Shales	5	"	
Limestone	0	"	6 inches.
Shales, with calcareous nodules	4	"	
Hard light gray limestone	2	"	
Bituminous shale	2	"	6 "
Argillaceous shale	16	"	
Coal	6	"	
	62	feet.	

A boring by Mr. Tijou, at this shaft, gave the following section below the coal seam:

Fire clay, with nodules of limestone	15	feet	10 inches.
Gray and blue shales	46	"	6 "
Bituminous shale	4	"	6 "
Coal	0	"	9 "
Fire-clay	5	"	5 "
Gray shale	8	"	4 "
Sandy shale and sandstone	31	"	6 "
Limestone	2	"	7 "
Bituminous shale	1	"	3 "
Coal	0	"	6 "
Fire-clay	3	"	9 "
Clay shale	17	"	1 "
Micaceous sandstone	0	"	10 "
Depth of boring	138	feet	10 inches.

At this point the work was suspended in consequence of breaking the drill; but it is the purpose of the enterprising proprietor to prosecute it, until the question is settled whether any of the lower seams are developed here thick enough to work. It is probably from one hundred and fifty to two hundred feet from the DuQuoin coal down to the lower coal at Murphysboro; and the determination of its existence below the DuQuoin coal in Perry county, under such favorable conditions that it could be worked at this point, is a matter of considerable importance to this county, and would justify such an expenditure of capital as is necessary to fully settle this question.

From the sections already given of the beds associated with the coal at Pinckneyville and DuQuoin, it will be seen that there are three, and sometimes four, different beds of limestone above the main coal, ranging in thickness from two to ten feet, and separated by argillaceous, calcareo-argillaceous, or bituminous shales. The upper limestones are usually of a light-gray or brownish-gray color,

quite hard and tolerably massive, affording layers from one to three feet in thickness. They contain numerous fossil shells at some localities, among which are *Spirifer cameratus, S. lineatus, Productus Prattenianus, P. longispinus, P. punctatus, P. Wilberanus, P. costatus* (?), *Athyris Royissii, A. subtilita, Chonetes mesoloba, C. granulifera, Meekella striato-costata,* and joints of *Crinoidea.*

The clay shale, which lies immediately above the main coal, and forms the roof, contains a variety of fossil plants, among which the following species have been obtained at DuQuoin and St. Johns, with others still undetermined: *Neuropteris rarinervis, Sphenopteris paupercula, Alethopteris aquilina, Pecopteris villosa, P. unita, P. plumosa, Cordaites borassifolia, Sphenophyllum Schlotheimii, S. emarginatum, Asterophyllites equisetiformis, Calamites ramosus, C. cruciatus, C. approximatus, Sigillaria sculpta, S. Brardii, Lepidodendron radicans, Lepidostrobus princeps, Megaphytum McLayi,* and *Caulopteris insignis.*

It is worthy of remark here that the fossil shells which characterize the upper limestones of DuQuoin and Pinckneyville, as enumerated above, are precisely the same species that are found in the roof limestones of the Belleville coal in St. Clair, Madison and Randolph counties; while no plants have been found in the roof shales of that coal at any of the many localities where we have seen it exposed in the counties above named; and furthermore, we have never seen any such bed of clay shale over the Belleville coal, along its western outcrop, as that which affords the fossil plants at DuQuoin and St. Johns, and, if the coals are identical, we must regard this clay shale, with its embedded plants, as a local intercalation that has not been seen at any of the typical localities of the Belleville coal. Hence, we are inclined to doubt the identity of these coals, and to consider the DuQuoin coal as identical with the Howlett coal, or No. 5 of the general section of the Illinois coal beds; and if so, then the Belleville coal would be represented by the little coal that is intercalated in the upper limestones of the Pinckneyville and Black Diamond sections, and this view is confirmed by the fact that this upper coal is considerably thicker on the western confines of the county than it is along the Central railroad, being from three to four feet thick at some of the exposures near the Randolph county line; while it is nowhere more than two feet in thickness in the eastern part of Perry county, and is often entirely wanting, or is represented by a mere streak of coaly matter. As we have already said elsewhere, these two coals are developed so near together, and are associated with beds which have so many features in common, being usually not more than forty or fifty feet asunder, and inclosed

between limestones closely resembling each other, that it is difficult to determine, if but one seam is exposed, to which horizon it should be referred. In St. Clair county, both seams outcrop in the river bluffs, at the old Pittsburg mines; but, as the lower one is much thinner there than the upper, or Belleville, seam, no attempt has been made to determine its thickness anywhere beyond its outcrop, or to ascertain its average quality. This will no doubt be done when the upper seam has been generally worked out, and the increased demand for fuel shall be such as to justify a thorough exploration of the entire thickness of the Coal Measures in that county, for an additional supply.

But little remains to be said in relation to the barren measures in the northern portion of the county. The soft micaceous sandstones and shales are frequently met with in small local outcrops in the ravines and on the streams, and Mr. ENGELMANN mentions a single outcrop of limestone in the northeastern corner of the county, which he refers to the Shoal creek limestone of Clinton county. This exposure is on the northeast quarter of section 13, township 4 south, range 1 west, and, with its associated beds, affords the following section:

Gray shale, with nodules of iron ore	3 feet	
Hard, bluish-gray limestone	5 "	
Shale	1 "	6 inches
Dark-blue slate	3 "	
Coal, said to be twelve inches	1 "	
Clay shale	6 "	
	19 feet, 6 inches	

This limestone is not reported in the Coloma shaft, sunk just north of the county line in Washington county, or any other beds that can properly be considered as the equivalent of the remainder of this section, unless it may be the band of impure iron ore, black shale and nine-inch coal, found about ninety feet below the surface in that shaft, which can scarcely be the representatives of this horizon. These beds are overlaid in the shaft by about sixty-five feet of sandstone and shale, and would seem to be too low down in the section to represent the Shoal Creek limestone. Local intercalations of calcareous beds are not uncommon in the Coal Measures; and it is quite probable that this limestone is of that character; or it may be that it overlies, entirely, the beds passed through in the Coloma shaft, and had been removed by erosion at that point. The Shoal Creek limestone occupies a position near the horizon of coal No. 9 of the general section of the Coal Measures of Central and Northern Illinois.

All the coals of this county thick enough to be worked with profit, except at some local points where the thin seams outcrop under the most favorable conditions, are those outcropping in the southern portion of the county, embracing the DuQuoin coal, the small coal above it, and the seams still below these, which outcrop in Jackson county, but have never been looked for in the region where the DuQuoin coal is found, because, as the latter occupies a much higher position in the series, it is more accessible, and can be worked at much less expense than the lower coals; but they may still be found here, and a shaft to reach them must probably be carried down to the depth of about two hundred feet below the coal at DuQuoin.

Economical Geology.

Coal.—It will be apparent, from what has already been said in regard to the geology of this county, that its principal mineral wealth consists in the vast deposits of bituminous coal which underlie its entire area, and in the southern portion of the county are found so near the surface that they can be worked as economically as any where else in the State. The DuQuoin coal is one of two heavy beds—Nos. 5 and 6—that occur about midway in the section of the lower Coal Measures of this State, and are the thickest coals we have, and the most persistent in their development of any in the series, except, perhaps, No. 2, or the lower coal at Murphysboro. In the central portion of the State, where the upper or "barren" measures are well developed, and where there is no extraordinary accumulation of Drift material above the Coal Measures, it is usually found at a depth of from two to three hundred feet, which depth gradually diminishes as we approach the borders of the coal field. In the southern part of Perry county, it is usually found from forty to eighty feet below the surface, and dips slightly to the northward, so that at the northeastern extremity of the county it is from two hundred to two hundred and fifty feet below the surface level.

The limestones which are associated with this coal outcrop in the ravines near DuQuoin, on the Beaucoup, from Pinckneyville, southward; on the Columbo, from the neighborhood of Galum, southward; and at numerous other points in the southern part of the county already noticed; and, wherever these outcrops of limestone occur, the coal may be found at a depth of from thirty to forty feet, requiring but a small investment of capital to put a mine in suc-

cessful operation. But, at the present time, little or no demand exists for coal off from the railroad line; and, until the completion of other roads, or the establishment of manufactories in this portion of the State, these vast deposits of mineral fuel can be made of little avail.

The DuQuoin coal is of excellent quality, above the average of our western bituminous coals; and, although at some points it contains considerable sulphuret of iron, this occurs mostly in nodules or lenticular masses, and can be readily separated from the coal in the process of mining. One reason for the bad reputation which our Illinois and other western coals have in Chicago and other markets, is the want of proper care, in mining, to separate the slate and sulphuret of iron (often called "sulphur") from the coal; and consequently the coals go to market with much of these deleterious substances mingled with them, which seriously affect their commercial value. This results from the carelessness of those in charge of the work, who allow the miners to send out of the mines the entire contents of the seam, including the sulphur and the slate as well as the coal, which they are prompted to do, because it adds so much to the amount of each day's product.

The DuQuoin coal averages fully six feet in thickness in this county, and has a good roof of hard, somewhat bituminous clay shale, which admits of taking out the entire thickness of coal, instead of leaving a portion to sustain the roof, as is usually done where the roof consists of soft material. At some points, as at Pinckneyville, the coal is directly overlaid by a hard, blue limestone, that forms a still better roof than the bituminous shale.

The coal is usually divided into distinct layers, averaging from six to twelve inches in thickness; the upper two feet of the seam being usually considered the best coal, is often separated from the other, and sold for smiths' coal. At St. Johns and DuQuoin, the difference between the top and bottom coal is less marked, and no separation is made. The sulphuret of iron occurs mostly in lumps and sheet, which can be easily separated from the coal; but there is some, occurring in very thin scales in the transverse partings of the coal, that can not be so readily separated from it; the quantity, however, is small. Some of the layers are very bright and compact, and have a resinous lustre and highly conchoidal fracture, while others are more dull and earthy, and contain considerable charcoal.

An analysis of the DuQuoin coal, by Mr. PRATTEN, gave the following result:

Specific gravity	1.246
Loss in coking	48.9
Total weight of coke	51.1—100
Analysis :	
Moisture	8.5
Volatile matters	40.4
Carbon in coke	48.1
Ashes (light gray)	3.0—100
Carbon in coal	59.6

This coal-seam is subject to some irregularities, such as "clay slips" or "horse-backs," sometimes called "faults" by the miners, which consists in a thickening of the roof shales, thus cutting off or pinching the coal-seam to one-half or three-fourths of its usual thickness. These irregularities may have resulted from a partial removal, by water currents, of the vegetable matter which formed the coal, and its replacement by a fine muddy sediment at a subsequent period. They are not "faults" in the sense in which that term is generally used in mining, which signifies a dislocation or displacement of the strata, so as to prevent their continuity on the original plane of deposit; for in this case there is no dislocation, but only a replacing of a part of the coal by the same material that forms the roof.

At the DuQuoin Central mine, the coal seems to differ somewhat from that obtained from the other shafts in this vicinity; and it lies about twenty feet nearer the surface than at the Mill shaft, on the same quarter-section, a half mile further north, while the general dip to the northward would not be sufficient to account for this difference of level. It is quite possible that this coal is really the upper seam, which has thickened here to five and a half or six feet, and that the other seam has not been reached at all in this shaft. By referring to the section of the shaft, it will be seen that there is only one bed of limestone above the coal, and that a similar limestone underlies it, with a foot or two of clay shale between; and the twenty feet of clay shale, which comes immediately above the coal at all the other shafts, is replaced in this one by five and a half feet of dark-colored bituminous shale. The upper layers of coal in this mine are remarkably free from all earthy matters, and the lamination is nearly obliterated; the coal has a resinous appearance, and breaks with a smooth conchoidal fracture. The bottom coal, however, is inferior, and contains thin seams of slate and iron pyrites. It is also more distinctly laminated; and the laminæ are separated by layers of carbonaceous clod, or mineral charcoal.

The roof of this mine is a very firm and highly bituminous slate or shale, which is crossed by numereous fissures running nearly east and west. This slate forms a very good roof, and permits the

taking out of all the coal from the mine. The coal is mined by blasting with powder at all the mines; and at the DuQuoin Central it is so compact that, after the removal of the bottom coal, a second blast is required to remove the top coal. Whether the difference between the coal at this mine and the others in this vicinity results from a local variation of the same seam, or whether it is really a different seam, is a point that we must leave to be fully solved hereafter; but it has many features in common with the No. 6 or Belleville coal, to which we are strongly inclined to refer it.

The amount of coal accessible at a very moderate depth in this county is enormous; and an estimate approximating the truth would probably astonish any one not familiar with the subject. We will base our estimate on the main seam at DuQuoin alone, leaving out of the count altogether the lower coals of Murphysboro and Carbondale, in Jackson county, which probably underlie this county also, and, calling the superficial area in the county four hundred square miles, we have the following result: Six feet in thickness of strata will yield, according to the usual mining estimates, 6,000,000 tons of coal to each square mile of surface; and for four hundred square miles we have an aggregate of 2,400,000,000 tons of coal, which, at $1.50 per ton, the average price at which it sells at this point, would yield $3,600,000,000, an amount more than sufficient to pay the whole national debt. This estimate is undoubtedly below rather than above the actual amount of the coal to be obtained from the beds underlying the surface of this county alone; and its abundance, and the facility with which it may be mined, from its proximity to the surface, and other favorable conditions, which have been fully stated above, will make this a desirable location for the establishment of the necessary manufacturing establishments to work up the vast agricultural products of Southern Illinois. There is probably no other county in the southern part of the State, where so great an amount of coal can be obtained with so small an expenditure of capital and labor as here; and the development of these vast resources of fossil fuel, as the increasing wants of the country shall demand, will greatly add to the industrial interests of this portion of the State. No satisfactory tests have yet been made to determine whether any of the coals from DuQuoin were sufficiently pure to smelt iron in their raw state; but it seems probable that a careful selection of the best coal from this region would lead to the accomplishment of this most desirable result, and this would bring the iron ores of Missouri to the coals of Southern Illinois, to be manufactured into metallic iron. The

completion of the railroad from Carbondale to Murphysboro will give an outlet for this coal to the western bank of the Mississippi river, about a hundred miles below St. Louis, and nearly opposite one of the most accessible points on the river to the great iron region of Missouri.

At the present time, the principal market for this coal is along the line of the Illinois Central railroad; and the annual product of the mines now opened in this county, for the year 1867, was about 200,000 tons, obtained from less than thirty acres of surface. These mines pay a royalty to the land-owner of 12½ cents per ton, equal to about $25,000 for the mining privileges on about twenty-four acres of surface; and at this rate the aggregate value of royalty to be paid to the land-owners for the coal in this county, from the DuQuoin seam alone, would be about $300,000,000.

Iron Ores.—Carbonate of iron is extensively distributed through the Coal Measures of this county, but generally in too limited an amount to be of much practical value. It occurs interspersed through the clay shales, in flat or kidney-shaped concretions, but seldom in a continuous body. When the streams cut through these shales, considerable quantities of ore may be seen along their courses, washed out from the banks of shale on either side, as on Swanwick creek, a short distance above the Pinckneyville and Nashville road. Similar ores are found in the shales penetrated in sinking wells on the south side of Grand Coti prairie, and at several other points in the county; and possibly it may hereafter be found at some locality in workable quantity.

Galena and *Native Copper* have been found in the superficial clays and gravel beds of this county; but these minerals do not belong to this region, and have been transported from the north, at the same time and by the same agencies which brought the granite and trap boulders with which they are here associated.

Building Stone.—Perry county is not well supplied with good building stone; nevertheless, the limestones of the southern portion, and the sandstones of the upper Coal Measures, which outcrop in the northern part of the county, afford material suitable for foundation walls, and some of the limestones may be safely used for bridges and culverts. The light gray limestone forming the roof of the little coal seam in the vicinity of DuQuoin and Pinckneyville, appears to be a durable building stone, and has been used in constructing culverts along the railroad north of DuQuoin. At some points this rock makes a very good quick-lime, as at Mr. Archie Wilson's, five miles southwest of DuQuoin. The arenaceous lime-

stone, which outcrops in the northeast part of the county, seems to be suitable for rough walls, and will supply the local demand in the vicinity of its outcrop. The sandstones are usually rather thin-bedded where we have seen them exposed in this county, and are too soft to be safely used in the construction of costly buildings; but they are easily dressed, and answer for light walls, flagging, etc. The sandstones outcrop most abundantly on the Little Muddy, in the northeastern part of the county.

Sand and *Clay*, for bricks, may be found at almost any place where it may be desirable to manufacture them; and, from the abundance of coal, and the economy with which they can be burned, brick will always be one of the cheapest and most easily obtained materials for building purposes in this county.

Agricultural Resources.—In discussing the topographical features of this county, we have already spoken of the prairie lands, the post-oak flats, and the barrens, and discussed the difference in the character of the soils to which these peculiar features of the surface may be attributed; and but little remains now to be said on this subject.

The bottom lands in this county are restricted to some narrow belts along some of the principal streams. On the Beaucoup they sometimes reach a mile or more in width, though usually they are narrower. The prevailing timber on this stream is the white oak, swamp white oak, bur oak, laurel oak, chestnut oak, red oak, sycamore, black walnut, sweet gum, scaly-bark hickory, etc. In the breaks and bluffs of the creek, the white oak, a tree otherwise not common in this country, is quite abundant, especially south of Pinckneyville; and these white oak lands are reckoned among the most fertile lands in the county. The soil on these bottom lands resembles somewhat that of the post oak flats. The sub-soil is a nearly white sand, with a small admixture of clay, and some ferruginous nodules; and the soil is composed of the same materials, with the addition of more vegetable matter, or humus. Although this post oak soil at first seems rather poor, it would probably improve rapidly under a judicious system of cultivation, its seeming deficiencies being due to its physical constitution rather than to a lack of any of the elements to form a good soil.

The bottoms on Columbo and Swanwick creeks are similar to those of the Beaucoup, and are covered with a similar growth of timber. On Reese's creek the bottoms are quite narrow in the south part of township 5, where the limestones outcrop, and are scarcely wider above; but in the vicinity of DuQuoin they widen to about three-

quarters of a mile. The principal growth of timber is the swamp white oak, scaly-bark hickory, black walnut, ash, over-cup oak, with an abundant growth of hazel as underbrush, which indicates a soil of good quality, and sufficiently dry for cultivation. Some miles lower down, the creek enters the bottoms of the Little Muddy, which are here two miles or more in width, and are heavily timbered with a growth similar to that on Reese's creek. At the crossing of the road, east of Old DuQuoin, the bottoms of Little Muddy are about a mile wide, and are covered with a splendid growth of swamp white oak, over-cup oak, scaly-bark hickory, red oak, ash, and some water oak, with but little hazel or other underbrush. At Kirkpatrick's bridge, on section 18, the bottom is about a mile wide, and averages this width as far north as the north line of township 6, and from this point gradually grows narrower to the north line of the county. A portion of these bottom lands is now too low and wet for cultivation; but they are valuable for timber, and will eventually become dry enough for farming purposes.

The character of the soils on the different varieties of upland in this county has already been briefly discussed; and but little remains to be said on this point. The soils and sub-soils consist mainly of an exceedingly fine sandy material, mixed with a smaller portion of clay; and its stiff, clayey appearance is more properly due to the fineness of the material than to the proportion of clay it contains. This peculiar character renders it close and compact, and hard to drain, and not easily worked, except when quite dry. Deep plowing or sub-soiling, and a liberal use of manures from the farm-yard, will rapidly improve the quality and texture of this soil, rendering it more porous, so that the water falling upon the surface will not be retained there, but allowed to pass freely through the soil into the earth below. When manures are not obtainable at a small cost, the same end may be attained by plowing under the green crops.

The *post oak flats* were entirely neglected by the early settlers, and the land regarded as unfit for cultivation; but they are now gradually being improved, and if judiciously treated, will eventually become productive. The growth of post oak timber by no means indicates a poor soil; and the arboreal vegetation of these flats is probably due to the mechanical condition rather than the chemical composition of the soil.

The prairies generally have a good soil, and produce annually large crops of cereals of various kinds; and yet the main difference between the soil of the prairie and that of the adjoining flats consists

in the larger amount of humus or vegetable matter which the former contains, derived from the long-continued growth and yearly decay of the grasses which everywhere cover the surface of the prairies. These annual crops of grass have added to the soil a large per cent. of organic matter, though far less than they would have done if, instead of being permitted to decay upon the surface, they had been turned under by the plow.

The *blue mud*, which has already been alluded to in treating on the drift deposits of this county, may prove to be a valuable manure, especially for the post oak flats. It appears to be composed mainly of leaves and partially decayed wood, with an admixture of clay, such as we often find accumulating in swamps or sloughs, and must contain, in a concentrated form, the organic elements, the humus, alkaline and other salts, which are the most valuable constituents of manures. It occurs at many localities in the county in great abundance, the deposit sometimes attaining a thickness of from five to ten feet; and, indeed, at one locality on the west side of Six-mile prairie, at Mr. Andrew Brown's, it was said to have been penetrated to the depth of sixteen feet without reaching the bottom. If this substance should prove to be as valuable as its appearance would indicate, it will add greatly to the productive capacities of the soils of this county, and, instead of being regarded as a nuisance, as it has hitherto been, will be eagerly sought after by the farmer, and liberally applied to his partially worn-out lands. An experiment could easily be made by any farmer living near a known outcrop of this material, and the application of a few loads to the poorest soil on the farm would in a year or two determine its value as a manure. Although it is generally found at a considerable depth below the surface level, it will most probably be found outcropping on some of the streams, and may thus be obtained with but little labor. Where it has been found in digging wells, it occurs from fifteen to twenty-five feet below the surface.

CHAPTER II.

JERSEY COUNTY.

This county lies upon the western borders of the State, at the junction of the Illinois river and the Mississippi, and includes an area of about ten townships, or three hundred and sixty square miles. It is bounded on the north by Greene county, on the east by Macoupin and Madison counties, and on the south and west by Madison county and the two rivers above named. The central and eastern portions are mostly prairie, and are comparatively level or gently rolling; while the western portion becomes more broken as we approach the river bluffs, which are intersected by deep ravines, separated by narrow ridges, many of which are from one hundred and fifty to two hundred feet in height. This portion of the county is heavily timbered.

The county is well watered by Macoupin creek and its tributaries, on its northern boundary, and by Otter creek and the Piasa and their affluents, which intersect the southern and western portions of the county.

The geological structure of the county presents an interesting and varied field for investigation; and the outcrops of the stratified rocks include a thickness of about one thousand feet of strata, ranging from the lower Coal Measures to the Trenton limestone of the lower Silurian period, inclusive. In addition to the stratified rocks, and overlying them, we find the usual Quaternary deposits, reaching an aggregate of a hundred feet or more in thickness, and consisting of alluvium, loess and drift. These deposits attain their greatest development in the vicinity of the river bluffs, and thin out to an average of not more than thirty or forty feet, after the general level of the high land is attained, where the loess disappears, and only the lower division of the series, the drift, remains.

The elevation of the Devonian and Silurian rocks to the surface in this county is due to the influence of the *Cap au Gres* axis, which crosses the Illinois river about five miles above its mouth, producing a dislocation of the strata, and forming a double tier of bluffs, which are separated by a narrow valley from the point where this axis first makes its appearance on the eastern side of the Illinois river, down nearly to Mason's Landing, the beds on the opposite side of this valley dipping in opposite directions, while those on the west side of this axis have been thrown down, so as to produce a decided fault in the stratification.

The following section will show the order of super-position and comparative thickness of the different groups of rocks occurring in this county:

	100 feet.	Quaternary.
Coal Measures.	200 feet.	Lower Coal Measures.
Lower Carboniferous.	6 feet.	Chester Limestone?
	70 to 70 feet.	St. Louis Limestone.
	150 feet.	Keokuk Limestone.
	200 feet.	Burlington Limestone.
	80 to 100 feet.	Kinderhook Group.
Devonian.	10 to 15 feet.	Hamilton Limestone.
Upper Silurian.	120 feet.	Niagara Limestone.
Lower Silurian.	40 to 50 feet.	Cincinnati Group.
	40 feet.	Trenton Limestone.

We shall briefly describe the strata represented in the foregoing section, taking them up in their order of sequence, beginning at the top of the series:

In the *Quaternary* system, we include the alluvium, loess and drift, comprising all the loose, superficial material that overlies the stratified rocks. The principal *alluvial* deposits of this county are the bottom lands bordering on the Illinois river, which form a belt on the eastern bank of that stream, with an average width of about one and a half to two miles. The soil on this bottom land is a deep sandy loam, formed mainly by the wash from the high lands of the adjacent bluffs, and the sediment deposited by the river, which submerges the lower portion of it during its annual overflows. It is exceedingly fertile, producing annually large crops of corn, wheat, oats, barley and potatoes, which are often grown year after year on the same ground, without manure, and with no perceptible diminution in the value of the crops. The surface of these lands is gradually being elevated from year to year by the causes already alluded to; the swampy portions are filling up, and the arable area is thus constantly increasing.

When the country was first settled, these bottoms produced annual crops of most luxuriant grasses, growing oftentimes, in wet portions, to a height of six or eight feet, and the annual decay of so great an amount of vegetable matter upon the surface produced a malarious atmosphere that was quite deleterious to the health of the early settlers upon these lands. But, when the soil was once broken and the ground brought under cultivation over a considerable portion of the surface, and the luxuriant growth of vegetation on other portions was consumed by the herds of cattle that were allowed to graze upon it, the general health of the settlers improved from year to year, until at the present time these bottom lands are considered to be quite as healthy as those upon the prairies, and more so than the timbered lands of the adjacent bluffs.

The river bluffs, both on the Illinois and Mississippi, are covered with a heavy deposit of *Loess*, varying from twenty to sixty feet in thickness. It presents its usual characteristic features in this county, and is composed of buff-colored marly sands and clays, sometimes partially stratified, and usually filled with shells of the common fresh-water and land varieties. It does not appear to extend very far back from the river, and its deposition is restricted to the slope between the general level of the prairie region and the bluffs bordering the river bottoms, while it appears to thin out rapidly as we recede from the river bluffs towards the higher portions of the adja-

cent country. It is also found filling some of the valleys of the smaller streams for several miles back from the river bluffs, showing that these valleys were excavated by other agencies than the streams which now run in them, and at a period anterior to the existence of our present water-courses. At Thos. K. Phipps' place, on the highlands between Otter and Coon creeks, heavy beds of loess and modified drift are found filling the lateral valleys leading to these streams, and also covering the slopes of the hills so that the underlying rocks are but rarely seen. These deposits are from sixty to a hundred feet in thickness; and the modified drift contains bands of sandstone and conglomerate. These sands are somewhat micaceous, and the particles of mica have excited expectations that these beds would afford valuable deposits of the precious metals. For a more minute description of the loess formation, the reader is referred to a previous chapter on the general geology of the State.

The drift deposits of this county do not present any peculiar features, so far as we are able to discover. One of the most satisfactory natural sections observed in the county was found on Otter creek, on the lands of Mr. McAdams, where the beds had been cut through by the waters of the creek. The exposure at this locality exhibited about twenty feet of yellowish-brown clay at the top, below which was seen from twenty to thirty feet of sand and gravel, with boulders; and this was underlaid by about fifteen feet of blue plastic clay, extending below the bed of the creek. Boulders of granite, sienite, green-stone, quartz-rock and porphyry, are often met with in the beds of the small streams, and have been washed out of the gravel bed, which forms the middle division of the drift in this vicinity. This gravel bed furnishes the main supply of water for the wells in this county, and the upper clay bed affords an inexhaustible supply of clay suitable for the manufacture of brick. About two miles southeast of Fieldon, on a small branch of Otter creek, a pottery has been established, and is supplied with clays from the drift, by using a mixture of blue plastic clay with the brown clay above. It makes a rather coarse and inferior quality of ware, by no means equal to that made from the argillaceous shales of the lower Coal Measures. But it seems quite probable that, by thoroughly washing the blue clay before mixing, it may be made to answer a valuable purpose for the manufacture of the coarser varieties of ware, such as drain-tile and the earthen cylinders used in sewers; and, as the supply of these clays, from the thickness of the beds, may be considered as unlimited, the question of its adaptability to such purposes should

be thoroughly tested. Fragments of wood, and even trees of considerable size, are often met with in sinking wells or in making other excavations in the plastic clay.

Coal Measures.

The rocks in this county that may properly be referred to the *Coal Measures* include a thickness of about one hundred and fifty to two hundred feet, embracing three or more seams of workable thickness. These coal beds underlie the eastern portion of the county, and outcrop on the Piasa at all points north and east of the Jerseyville and Alton road, as well as on the southern affluents of the Macoupin. On the extreme western confines of the coal region the measures are thin, and are sometimes composed entirely of sandstones and shales, with no coal of any value; but as we proceed eastwardly, toward the center of the coal field, the measures increase in thickness, and the seams of coal become more numerous. The following section, compiled from the various local sections we were able to see, may be taken as the approximate thickness of the measures in this county:

Gray shale, partially exposed west of Brighton	10	feet
Compact, brownish-gray *Fusulina* limestone	6	"
Brown calcareous shale	3	"
Green and blue argillaceous shale	8 to 10	"
Coal No. 6	2½ to 3	"
Shaly clay	1½	"
Calcareous shale, with bands of limestone and septaria	6	"
Clay shale	8 to 10	"
Limestone and bituminous shale	3	"
Coal ("Howlett seam") No. 5	3 to 4	"
Shaly fire-clay	1 to 2	"
Nodular argillaceous limestone	4	"
Gray shales	30	"
Bituminous shale, sometimes overlaid with limestone, probably representing the horizon of coal No. 2	3 to 4	"
Sandstone and shale	40 to 50	"
Coal No. 1?	2 to 3	"
Clay shale	2	"
Nodular, dark-blue, compact limestone, in local outcrops	3 to 5	"
Shales and sandstone	10 to 20	"

The upper beds in this section, including the two upper coal seams, were only seen exposed together at one locality in the vicinity of Brighton, in the southeast corner of the county, on the head-waters of the Piasa, and about one mile west of the town. The upper limestone in the section above is a gray, compact stone, weathering to a rusty brown color, and sometimes occurs in massive strata, from two feet to two and a-half in thickness, with its surface thickly

covered with *Fusulina*. It also contains plates and spines of *Echinochidaris, Athyris subtilita* and *Spirifer lineatus*. From the calcareous shale below the limestone, we obtained very large joints of crinoidea, *Productus semireticulatus, P. longispinus, Spirifer lineatus, S. Kentuckensis, Retzia Mormoni, Chonetes mesoloba, C. granulifera*, an undetermined *Platyceras*, etc.

The upper seam at this locality, which we refer without hesitation to the horizon of coal No. 6, of the general section, has been opened here by drifting into the hillside along the line of outcrop, and has also been passed through in the shafts which have been sunk in this vicinity down to the lower No. 5 coal. It is somewhat thinner here than the lower seam, and has a roof of clay shale that requires thorough cribbing to enable the miners to work the coal with safety; and for these reasons they prefer to work the lower seam, which has a better roof, and is also somewhat thicker than the one above it. These coals are separated here by from twenty to thirty feet of shaly strata, and are both underlaid by a calcareous clay shale, passing into hard argillaceous limestones, which are generally concretionary, and sometimes appear as nodules of limestone embedded in the shale.

The lower seam is overlaid by a brown argillaceous limestone, which sometimes comes immediately above the coal, or is separated from it by a thin bed of bituminous shale. At the openings near Brighton, the seam ranges from three feet to three feet nine inches in thickness, and affords a coal of fair quality, but containing more sulphuret of iron than the coal from the upper seam, which is here considered the best smith's coal.

At Samuel Austin's place, on the southeast quarter of section 10, township 7, range 10, this seam has also been opened, and the coal from this mine is said to be the best yet found in the county. It ranges from three and a-half to four feet in thickness, with a good slate and limestone roof, and is said to afford a good coking coal.

At Andrew Williamson's place, on section 16, in the same township, the coal has about the same average thickness; and the exposure here afforded the following section from the creek to the coal:

Limestone, compact and brownish-gray	4 feet
Coal No. 5	3½ to 4 "
Shaly fire-clay	4 to 6 "
Gray nodular limestone	4 "
Shale, partially exposed	25 "
Bituminous shale (coal No. 2?)	2 to 4 "
Shale, partly exposed down to the creek level	22 "

This seam has also been opened on the southwest quarter of section 10, township 7, range 10, where it is about five feet thick, and was worked by Mr. Langley, in 1854, at the time of our first visit to this county. The coal afforded by this seam varies considerably at the different mines where it has been worked. At some localities it contains considerable sulphuret of iron, and cannot be used for blacksmithing; at others it is quite free from it, and becomes a good smiths' coal. It everywhere contains carbonate of lime, in thin white plates, traversing the cleavage joints of the coal; and at some localities the sulphate of lime, or selenite, in thin crystalizations, is found in it, but these calcareous minerals do not affect the quality of the coal injuriously, like the combinations of sulphur and iron.

This seam, from the localities above cited, affords nearly all the coal at present mined in this county. It will probably be found to underlie the greater part of townships 7 and 8, range 10. The strata appear to lie very nearly horizontal, though at the Langley mine the coal dipped to the northeast sufficiently to drain the mine through the adit which enters the hill in a southwesterly direction. This is probably the general direction of the dip in this vicinity.

The lower seam, which is exposed on the Piasa, east of Delhi, has been opened at various localities along the bluffs of the creek, within a distance of two miles from the town. The coal varies in thickness from two to three feet, and is overlaid by a few inches of bituminous shale, which passes upward into a brown or chocolate-colored clay shale. It is underlaid by fire clay, the thickness of which was not determined, and about ten feet of sandy shale and sandstone, which rests directly upon the St. Louis limestone. About half a mile west of Langley's mine a dark bluish-gray concretionary limestone is seen in the bed of the creek, from three to four feet in thickness, which is overlaid by ten or twelve feet of gray shale. This limestone closely resembles that usually underlying the Exeter coal seam in Greene and Scott counties; but if it is the same, the coal is wanting here. We also saw a similar limestone a half mile north of Delhi, in a small ravine on the west side of the Jerseyville road; but no coal seam appeared to be associated with it here. If this is the limestone usually associated with the No. 1, or Exeter, coal, then the seam which has been opened on the Piasa, near Delhi, and underlies this limestone, would be the Conglomerate coal, and the equivalent of a thin coal found below Moore's coal, on the Little Sandy, in Scott county, in a similar position, for a description of which, see the report on that county, in a following chapter. The coal

which this seam affords is much inferior in quality to that obtained from the higher seams, and consequently it is not much worked at the present time. Coals Nos. 2, 3 and 4 of the general section do not appear to be well developed in this county.

The western boundery of the coal field, in that part of the county lying north of Jerseyville, is not well defined, in consequence of the scarcity of any rock exposures below the drift. In sinking a well at the steam mill in Jerseyville, a few feet of soft micaceous sandstone were passed through, which no doubt belong to the Coal Measures. From Jerseyville the general trend of the western borders of the Coal Measures is to the northeast; and, on Phill's creek, at J. Fink's place, on section 29, township 9, range 10, a thin-bedded micaceous sandstone is exposed, about six feet in thickness, and extending below the creek level. Some of the layers are finely ripple-marked; and the rock, when of the proper thickness, makes a good flagging-stone. The streams in the northeast part of the county run through broad valleys, filled with drift to such a depth that the stratified rocks are rarely exposed; and, consequently, it is impossible, without artificial excavations, to determine the precise line of boundary between the different formations. The sandstone on Phill's creek is no doubt a Coal Measure deposit, and probably the same as that penetrated at the mill in Jerseyville. It probably represents the sandstones lying near the base of the Coal Measures. Two miles nearly due north of Jerseyville, in the bed of a creek, a chert bed is exposed on the southwest quarter of section 4, which no doubt belongs to the limestones below the Coal Measures.

Passing below the Coal Measures, we come directly upon the lower Carboniferous limestone series, the different members of which form a broad limestone belt that extends from the western borders of the Coal Measures to the river bluffs. The limestone formation is mainly represented by the four divisions mentioned in the general section; but, at two or three points in the county, we saw some beds of arenaceous material, lying between the Coal Measures and St. Louis limestone, that appeared like thin outliers of the Chester group. On the southwest slope of Beatty's Mound, in a little run which empties into Otter creek, we found a stratum of white sandstone or siliceous limestone, about one foot in thickness, containing *Retzia vera*, *Athyris ambigua*, and an undetermined shell like a *Modiola*; and below this stratum a few feet of thin-bedded sandstone was seen, which rest upon the St. Louis limestone. At Cooper's quarries, about three miles southwest of Jerseyville, the St. Louis limestone is overlaid by similar beds, consisting of about four feet of brown ferruginous

sandstone, and about two feet of light gray calcareous sandstone, very much like that at Beatty's Mound, except that it contained no fossils, so far as we observed, at this locality, and was associated with some thin beds of chert. Nodules of a fine iron ore were found here in the shaly portions of the brown sandstone, underlying the light gray rock. The lithological character of these beds, and their stratigraphical position, would tend to confirm the conclusion that they are the attenuated representatives of the beds above named, even in the entire absence of characteristic fossils. In Randolph county, this group has an aggregate thickness of more than six hundred feet; but it thins out rapidly toward the north, and, in the bluffs at Alton, we recognize it with an aggregate thickness of only about fifteen feet. In Jersey county, the beds representing this group are only from six to seven feet thick; and north of this county, they have not yet been recognized at all; and, if they were deposited at points further north, the strata have been worn away by the denuding forces which seem to have been in active operation at the commencement of, or anterior to, the coal-bearing period.

St. Louis Limestone.—This formation appears to be considerably thinner in this county than in Madison, and also changes somewhat in its lithological characters, on the north side of the Piasa. No single section was seen in this county that exhibited a greater thickness than about seventy-five feet of this limestone; and its maximum thickness in the county probably does not exceed one hundred and twenty feet. About one mile above the Piasa, the upper portion of the river bluff consists of about seventy-five feet of strata that may be referred to this formation, consisting of buff and brown magnesian limestones. The upper half of the bed is here a thin-bedded, buff-colored limestone, that becomes shaly on exposure to the atmosphere; while the beds below are tolerably massive, affording layers from one to two feet in thickness. These lower beds contain *Spirifer lateralis*, *S. Keokuk*, *Orthis dubia* and a *Syringopora* of undetermined species. Below these massive beds we find about six feet of earthy, ash-colored, hydraulic limestone, the same, probably, that is quarried at the cement mill on the Piasa. Under the hydraulic limestone there is a covered slope of sixty feet in which the strata are not exposed; and below this slope there is an exposure of one hundred and twenty feet of Keokuk limestone, extending to the river level. The beds forming the upper portion of the bluff at this point present the same general characters observed a short distance west of Delhi, where this limestone is immediately overlaid by the Coal Measures; and the heavy beds of evenly-stratified and concretionary gray lime-

stone, which form the upper division of this formation at Alton and St. Louis, are scarcely represented at all in this county.

At the hydraulic mill owned by the heirs of the late Robt. G. Smith, Esq., on the north side of the Piasa, the hydraulic limestone is eight feet in thickness, and is underlaid by about thirty feet of shaly magnesian limestone, extending down to the level of the creek. Overlying the hydraulic limestone at this locality, are beds of brown magnesian limestone, similar in character to that just described as overlying the hydraulic limestone in the section at the river bluff, and containing the same fossils, with some additional species, such as *Rhynchonella subcuneata* and *Palæacis cuneatum*.

On the Piasa, two miles southwest of Delhi, a series of brown and gray limestones are exposed in alternating beds, which attain a thickness altogether of about forty feet. Some of the brown beds are quite soft, and weather to a brown calcareous shale. The gray beds are compact and massive, and afford a good building stone. The abutments for the railroad bridge on the Piasa are built from the gray beds which outcrop in this vicinity. The strata at this locality afford the same fossils already named as characteristic of these limestones at other localities in this county; and I also saw, in the cabinet of Dr. Farley, of Jerseyville, a specimen of *Melonites multipora*, which he informed me was obtained at the quarries two miles west of Delhi, associated with *Rhynchonella per-rostellata*, and the species above named.

Cooper's quarries, on a branch of Otter creek, about three miles southwest of Jerseyville, are in this formation; and the rock at this locality presents the same general characters as at the other localities already mentioned.

This group thins out toward the north; and, although no satisfactory exposure of the bed was seen northwest of Jerseyville, we will hazard the opinion that it nowhere exceeds a thickness of forty or fifty feet in the northern part of this county.

About five miles above Mason's landing the St. Louis limestone is found, forming a part of the river bluff, where it has been thrown down by the dislocation of the strata at the point where the Cap au Gres axis crosses the river. The beds exposed here present the same lithological characters as at Alton, and the rock is quarried and burned for lime. The beds here dip nearly south, at an angle of about twenty-five degrees. There are from forty to fifty feet in thickness of these gray limestones exposed here; but the strong dip soon carries them below the surface, and the extent of the outcrop is quite limited.

Keokuk Limestone.—This formation, which underlies the St. Louis limestone, has a maximum thickness in this county of about one hundred and fifty feet. In the bluffs of the Mississippi, between Jersey Landing and the Piasa, it is well exposed, and forms the upper part of the bluff, a half mile below the first named point; but a gentle dip down the river, or in an easterly direction, soon brings it down to the river level; and, about a mile and a half above the mouth of the Piasa, it forms only the lower portion of the bluff, while the upper part is formed by the St. Louis limestone, as described in a foregoing section. The upper part of the formation is hidden at this locality by a covered slope about sixty feet in thickness; but, on the branches of Otter creek, it is found to consist of blue and buff-colored calcareo-argillaceous shales, such as usually characterize that portion of the formation known as the *geode bed;* and it is here, as elsewhere, filled with siliceous geodes, containing crystals of calcite, quartz and the common botryoidal forms of chalcedony.

The lower part of this group, comprising about two-thirds of its aggregate thickness, may be described as a thin-bedded, cherty, bluish-gray crinoidal limestone, with partings of blue or yellow marly clay between the beds. It is well exposed on the forks of Otter creek, between Grafton and Jerseyville; and sections of the strata from twenty to forty feet thick may be frequently seen along the bluffs of these streams. It is generally thin-bedded, seldom affording strata more than a foot in thickness; and these are usually separated by thin seams of marly clay. On the surface of the limestone layers, where the clay has been removed by weathering, the characteristic fossils of this formation may be obtained in a fine state of preservation. Very fine specimens of *Archimedes Owenana* have been found here; also *Oligoporus Danæ, Agaricocrinus Americanus, A. Wortheni, A. Whitfieldi, Actinocrinus Nashvillæ, A. Mississippiensis, Productus punctatus, P. semireticulatus, Athyris incrassata* and *Zaphrentis Dalii,* which are the most common fossils afforded by these limestones on Otter creek. Northwest of Jerseyville, where this limestone undoubtedly forms the fundamental rock on which the Quaternary deposits rest, no considerable exposures of it were found, for the reason that there are no streams on the south side of the Macoupin, and west of Phill's creek, of sufficient size to cut through the superficial deposits and expose the rocks below.

Burlington Limestone.—This important subdivision of the lower Carboniferous limestone series is well developed in this county,

with an aggregate thickness of about two hundred feet, and underlies a belt of country several miles in width along the river bluffs, throughout nearly the whole extent of the county from northwest to southeast, until it finally passes below the river level a short distance below Jersey Landing. Immediately below Jersey Landing, the bluff is composed entirely of this limestone, and is one hundred and ninety feet in height above the river. It consists of alternate layers of light-gray and brown limestone, with a considerable amount of cherty material disseminated through it in seams and nodules. About midway of the mass, at this locality, there is a bed of yellow, partly decomposed chert, from fifteen to twenty feet in thickness; and above this the limestone becomes more thin-bedded and cherty than it is below. The lower part of the formation is a regularly-bedded light-gray limestone, the strata ranging from six inches to two feet in thickness, and appearing to be composed almost entirely of the plates and joints of crinoids, forming what is termed a *crinoidal* or *encrinital limestone*. The remains of crinoids in a good state of preservation, however, are extremely rare in this formation at every locality we were enabled to examine in Jersey county; and in this respect it presents a marked contrast to the outcrops of this limestone at more northern localities. The principal fossils which it affords in Jersey county are *Euomphalus latus*, *Productus semireticulatus*, *Spirifer plenus*, *S. Grimesi*, *S. striatus*, *Orthis Michelini*, *Athyris lamellosa*, and *Chonetes Illinoisensis*.

The limestone bluffs in the vicinity of Jersey Landing are exceedingly bold and picturesque. They are capped by heavy beds of Loess, which makes the entire elevation from two hundred and twenty-five to two hundred and fifty feet in height, with a precipitous limestone cliff from one hundred and fifty to two hundred feet high. At the time of our last visit to this locality (in May, 1864), a pair of eagles, guided by that instinct which leads these birds to select the most inaccessible location for their breeding places, had built their nest upon a projecting shelf of limestone, about thirty feet below the summit of the perpendicular limestone cliff, about half a mile above the village. Below them was a mural wall of limestone, nearly one hundred and fifty feet high, and from above they could only be reached by a rope let down—a feat which but few would be bold enough to undertake. While we were prosecuting our examinations at the foot of the bluff, the male bird sat perched upon a tree at the summit of the cliff, keeping a vigilant watch, while its mate occupied the nest below.

The view from the summit of these bluffs is very fine, and will well repay the labor of climbing to the top. To the south the turbid Missouri, and the rich fertile valley which separates the two great rivers at this point, can be seen for many miles in extent from east to west; while the broad reaches of the Mississippi, which here runs nearly due east, form a magnificent foreground to the picture.

From Otter creek to the Macoupin the bluffs are formed mainly of this limestone, with an occasional outcrop of the Kinderhook group at the base; and in the vicinity of Fieldon it outcrops on all the smaller streams.

At Theodore Lance's lime-kiln, on Borer creek, this limestone forms perpendicular bluffs from forty to fifty feet in height. The rock here presents its usual characters of a light gray crinoidal limestone, with cherty seams and nodules, and is quarried for lime-burning. A bed of chert four or five feet in thickness forms the top of the exposure at this point. The quarries at this locality afford the same fossils already mentioned as occurring near Jersey Landing. Near the mouth of Sugar creek a hundred feet or more in thickness of this limestone may be seen at a single exposure.

At the farm of Mr. James Reddish, on the southwest quarter of section 4, township 8, range 13, this limestone, with the upper part of the Kinderhook group, forms a nearly perpendicular bluff more than a hundred feet high. The rock forming the upper part of this exposure is a massive gray limestone, with a few seams of chert. *Strophomena analoga*, *Spirifer Grimesi* and *Euomphalus latus* were obtained here. This rock is frequently intersected by fissures, which sometimes lead into caverns of considerable extent, and also afford an outlet to subterranean streams of water, which gush from the base of these bluffs in perennial springs.

In the vicinity of Mason's Landing this limestone forms the upper bench in the high bluffs back of that point; and the beds of the small streams are filled with fragments of chert, derived from this formation by the decomposition of the calcareous portions of the mass. These cherty masses often afford delicate and beautiful casts of the crinoids and other characteristic fossils of this formation.

Kinderhook Group.—This group forms the base of the lower Carboniferous limestone series in this portion of the State, and rests directly upon the Devonian shales. In this county it consists of thin-bedded, ash-colored, impure earthy limestone, with some massive layers of dolomitic limestone in regular beds. The shaly portions contain nodules of calcite, resembling geodes, which are coated with a very thin outer crust of chalcedony. About four miles below

Grafton, this group measures about a hundred feet in thickness. The lower part consists of thin beds of impure cherty limestone, of a brownish-gray color, which contain the nodules of calcite above mentioned; and this is overlaid by a regularly bedded brown dolomitic rock, from fifteen to twenty feet in thickness; and this is again overlaid by ash-colored cherty beds, which pass upward into the overlying Burlington limestone, with no well-defined line of demarcation between them. The arenaceous beds, so characteristic of this group at the typical locality, as well as at other more northerly points, are here replaced by calcareous strata. A few fossils were obtained from this group in the vicinity of Grafton, among which were *Spirifer Vernonense*, *Athyris Prouti*, *Strophomena analoga*, *Productus semireticulatus*, and several species not yet determined.

The outcrop of this formation is confined to the vicinity of the river bluffs; and from Otter creek to the Macoupin there is a continuous exposure of this group at the base of the bluffs, wherever the beds are not covered by a talus from the overlying limestone.

The slates and shales that form the lower division of this group are represented in this county by from twenty to thirty feet of green shale, including, at some localities, a bed of black bituminous shale or slate, from which fact it is often supposed to contain coal, and much labor has been expended in the search for it at several points in the county. These explorations have generally been undertaken by the advice of those professedly acquainted with coal mining, who, having learned in the prosecution of their labors as coal miners, that black slates are usually associated with the coal seams, are nevertheless quite ignorant of another and equally important fact, namely, that bituminous slates are not always associated with bituminous coal, and sometimes do not even belong to the Coal Measures, as is the case with the slate now under consideration. Hence, these slates are known in mining parlance as "coal blossom"; and miners are always found that are ready to recommend a search for coal wherever beds of this kind appear, utterly regardless of the geological horizon to which they belong. This has resulted in the useless expenditure of more money, in nearly every county where these shales are exposed, than a complete scientific survey of the county would have cost. The bituminous slates and shales of the older systems can only be distinguished from those of the Coal Measures by a careful examination of the strata associated with them, a work which ordinary coal miners are in no way qualified to perform, and hence their judgment is not to be relied on.

The outcrop of this formation in this county is confined to the river bluffs between Grafton and Otter creek, extending up the valley of the last named creek for about two miles. Nodules of iron pyrites abound in the shales at some localities; but they afford no material of value for economical purposes, and in this county have thus far afforded but few fossils.

Hamilton Limestone.—Below the shales above named, and resting upon the Niagara limestone, we find a thin bed of earthy, brown limestone, from eight to fifteen feet in thickness. The rock appears quite massive in newly opened quarries; but on exposure at the surface it splits into thin shelly layers, and hence will not prove to be a reliable building stone. At some localities the bed has somewhat the appearance of a hydraulic limestone; but its value in this respect has not been thoroughly tested. It is well exposed in the town of Grafton, where, by an undulation of the dip, the bed is brought down to the level of the town, though occupying a much higher position both above and below. We found in the beds at this locality *Strophomena fragilis, Atrypa reticularis,* and joints of *crinoidea,* with some *fish remains.* A thin layer of shaly limestone, at the junction of this bed with the Niagara limestone, is filled with silicious corals belonging to the genus *Cystiphyllum;* but their specific characters have not yet been determined. About a mile back of Mason's Landing, this bed is exposed near the place where the attempt was made to find coal in the overlying shale. It is here only about eight feet in thickness, and presents the same appearance as at Grafton. Just below the mouth of Otter creek it is found exposed, forming the base of the bluff, and is here about fifteen feet in thickness. The beds at this point appear to stand exposure better than at the other localities mentioned; and they may afford some good building stone. They are here overlaid by about four feet of brittle, bluish-gray, or dove-colored limestone, that resembles in some respects the Lithographic limestone of the Missouri Report; and, if they represent that rock, the black slate must be wanting at this point.

Niagara Limestone.—This important division of the upper Silurian system is well exposed in this county, forming a considerable portion of the river bluffs from a point about a mile below Grafton to Otter creek, where it disappears with a north-easterly dip below the surface. It has a thickness in this county of about one hundred and twenty feet, and is a buff-colored dolomitic limestone, in regular beds, which vary in thickness from four inches to three feet. The quarries in the vicinity of Grafton present a perpendicular face of

this rock, about forty feet in height, embracing the upper part of he formation. The rock is even-textured, cuts easily when freshly quarried, but hardens on exposure, and is remarkably free from chert or other silicious material. Mr. PRATTEN'S analysis of this rock gave the following result:

Carbonate of lime	50.15
Carbonate of magnesia	42.20
Peroxide of iron and alumina	2.10
Insoluble matter	5.15
Loss	.40—100.00

It is undoubtedly the exact equivalent of the "Joliet limestone," and in its general character and appearance corresponds very nearly with the buff-colored beds at that locality. The color of the rock is much more uniform in this county than at Joliet; and it does not present those alternations of buff and gray which characterize the different strata at more northern localities; and, as a reliable building stone, it is not surpassed by anything at present known in the Mississippi Valley. Fossils are not very abundant in it; but the quarries at Grafton afford *Calymene Niagarensis*, *Lituites Capax*, and *Orthoceras annulatum?* The outcrop of this formation is confined to the bluffs of the Illinois and the Mississippi in this county, nowhere appearing at the surface at any considerable distance from the rivers.

Cincinnati Group.—The lower Silurian system is only represented in this county by the shales of the Cincinnati group, and about forty feet of the upper part of the Trenton limestone, which appear at only a single locality, about five miles above Mason's Landing, on the northeast quarter of section 9, township 6, range 13, where the *Cap au Gres* axis crosses the Illinois river. Owing to the soft argillaceous character of the shales at this locality, they are nowhere well exposed, but are usually covered up by the debris along the base of the bluffs, exhibiting only at intervals slight exposures of a light-gray, shaly clay, somewhat resembling the fire-clays of the Coal Measures. Their outcrop extends from the point above named to within about a mile of Coon creek, where they dip below the surface. This group contains some plates of dark-brown sandstone, and nodules of iron pyrites. Its thickness we were not able to determine accurately by measurement, but have estimated it approximately at from forty to fifty feet. No fossils were found in it in this county, and no indications were seen of the presence of the bituminous shales and slates which are characteristic of it at more

northern localities. It appears to be mainly a light, bluish-gray clay shale, that weathered on exposure to a pure clay, apparently suitable for potters' use.

Trenton Limestone.—This formation only appears above the surface at one point, which is on the northeast quarter of section 9, township 6, range 13, where about forty feet of the upper part of it is exposed. The rock is thin-bedded, compact, and of a light-gray color, splitting easily with an uneven cleavage. The rock has been quarried here, at Williams' lime-kiln, for lime-burning, for which it is tolerably well adapted, though by no means equal to the St. Louis limestone, which is quarried for the same purpose on the other side of the axis, a half mile below. This outcrop of Trenton limestone is on the northerly side of the axis, and the rocks dip to the northeast; but, immediately below, the dip is reversed, and the Niagara limestone and the whole series of Devonian and lower Carboniferous limestones are thrown down in a distance of half a mile. The two lime-kilns, situated less than half a mile apart, are thus supplied by two distinct limestone formations, which, if remaining in their normal position, would be separated from each other by a thickness of at least eight hundred feet of strata; but here, by the sudden dislocation and downthrow of the beds, are brought in close proximity to each other. This axis of disturbance gives origin to a double series of bluffs, which extend from this point nearly to Mason's Landing, with a deep valley between, with the strata on either side dipping in opposite directions. All the Silurian and Devonian strata that appear above the surface in this county have been elevated by the disturbing forces that formed the axis above described; and they soon pass below the surface, as the influence of this elevating movement diminishes in either direction.

Economical Geology.

Coal.—Although there are three or four distinct seams of coal cropping out in this county, but one of them is mined to any considerable extent at the present time (1864). This is the No. 5 coal of the general section, and varies in thickness in this county from three to five feet. It is the equivalent of the lower seam in the old Pittsburg mines, in St. Clair county, and the lower seam on Hodge's creek, at the east line of Greene county. It affords a coal of fair quality, and is capable of yielding four million tons of coal to every section of land which it underlies.

The upper seam we were not able to examine in a very satisfactory manner, but were informed that it was from two and a half to three feet in thickness, where it has been opened, and afforded a coal of fair quality; but, in consequence of the shaly character of the roof, it has not been much worked, except along the outcrop of the seam, where the coal was dug in open trenches by throwing off the superincumbent clay and soil. In could be worked in the usual manner by drifting, but the entry would require thorough cribbing to support the roof. The middle or No. 5 seam has a good limestone roof, and consequently can be mined much more easily and safely than the upper seam.

Below the middle seam are there from sixty to eighty feet of shales and shaly sandstones separating it from the lower seam, which appears to be the equivalent of coal No. 1, or possibly it may be even lower, and represent a Conglomerate coal. It affords a coal of rather inferior quality, owing to the sulphuret of iron which it contains; and, since the opening if the upper seam, the lower one has been generally abandoned. These coal seams are mainly restricted to the eastern tier of townships in this county.

Clays.—As has already been observed in our remarks on the drift deposits of this county, a pottery has been established near Fieldon, the material for which is obtained from the plastic clay at the base of the drift, which answers tolerably well for the manufacture of a coarse quality of ware. But the clays that are usually found associated with the lower coal seams afford a much better material for the manufacture of potters' ware or fire-brick, and may yet be found in this county.

Hydraulic Limestone.—A bed of this useful material is found in the bluffs of the Piasa, intercalated in the lower part of the St. Louis limestone. The bed is about eight feet in thickness, and is quarried by drifting into the face of the bluff. It is about forty feet above the Piasa; and the hydraulic rock is overlaid here by heavy beds of buff-colored magnesian limestone. Below the hydraulic rock, the beds become shaly, and pass downward into the calcareo-argillaceous shales of the geode bed of the Keokuk group. Smith's cement mill, erected at this point, has capacity to grind two hundred barrels per day. This hydraulic bed also crops out in the river bluffs, above the mouth of the Piasa, and may undoubtedly be worked at several localities, should the demand for it warrant increased facilities of manufacture.

Quick-lime.—All the main limestone formations in the county afford more or less material adapted to the production of lime,

though the best article will probably be obtained from the Carboniferous limestones. The compact bluish-gray beds of the St. Louis limestone, and the light-gray limestone of the Burlington series, afford an inexhaustible supply of the very best material for this purpose. Some of the beds of the Keokuk limestone on Otter creek may be used for this purpose, and will supply the local demand in that part of the county.

Iron Ore.—No indications of the existence of any extensive deposit of iron ore were observed, though there is a band of dark-red hematite occurring in the sandstone overlying the St. Louis limestone at Cooper's quarries. The ore appeared to occur only in nodules, and not in sufficient quantity to be of any value. It affords, however, some interesting specimens of this variety of ore. Although only seen at a single locality, it will no doubt be found at other points in the county occupying the same horizon.

Building Stone.—Of all the natural resources of this county, except coal, there is none that will eventually conduce more to its wealth and general prosperity than its unlimited supply of superior building stone. Of the five important limestone formations in this county, all afford more or less building stone of good quality; while the Niagara limestone, the most important of all, will afford an inexhaustible supply, which, in point of quality, is not excelled by anything of the kind at present known in the Mississippi Valley. Its outcrop being entirely confined to the river bluffs, it can be easily transferred from the quarries to barges, on which it can be cheaply conveyed to any desired point on the Illinois or the Mississippi rivers. It is a regularly-bedded, even-textured, buff-colored dolomite, easily cut into any desirable form, and one of the most durable rocks in the State. It affords strata of every desired thickness, from four inches to three feet. The thinnest beds afford a good flagging-stone; while the thicker ones furnish dimension-stone of any desirable size. The material for the old *Lindell Hotel*, in St. Louis, was obtained from the Grafton quarries, and it would hardly be an exaggeration to say that this bed of limestone, alone, will afford material enough in this county to build a continuous city from the mouth of the Illinois river to St. Louis. It is at least one hundred and twenty feet thick, and outcrops from Otter creek to a point about a mile below Grafton, where it finally dips below the river level and disappears.

The Burlington limestone, which forms the entire bluff in the vicinity of Jersey landing, also affords an excellent building stone, and has been used for the construction of mills, ware-houses and

dwellings at that point. It is nearly white in color, cuts easily, and is an excellent material for caps and sills, where a light-colored rock is desired. It is not as evenly bedded as the Niagara limestone and contains some seams and nodules of chert.

The St. Louis limestone affords an abundant supply of material for rough walls and heavy masonry, at all the localities where it outcrops in this country. On the Piasa, anywhere from the bridge on the Jerseyville and Alton road to the river bluffs, this limestone may be found, and will afford all the material for foundation walls and heavy masonry that may be needed for local use.

The Keokuk limestone, in its outcrop on Otter creek, will also furnish some tolerably good building stone; but it is generally unevenly bedded, and contains much cherty material.

That part of the county lying east of Jerseyville is very poorly supplied with building stone; the sandstones and thin beds of limestone belonging to the Coal Measures being the only rocks that outcrop in this part of the county. The shaly sandstones below the main coal seams crop out on the Piasa, in the southeast part of the county, and afford some material suitable for walling wells, etc., but too soft for heavy masonry. At J. Fink's quarries, on Phill's creek, northeast of Jerseyville, a similar sandstone is found, that answers very well for flag-stones and light walls. The brown *Fusulina* limestone, that crops out about a mile west of Brighton, is a very hard and durable rock, and will supply the local demand for culverts and foundation walls in the vicinity of its outcrop.

Soil, Timber, etc.—The topographical features presented by the uplands in this county are quite varied. Adjacent to the bluffs of the great rivers which form the southern and western boundaries of the county, and extending back for a distance of from three to six miles, the surface is broken into steep ridges, which are separated by deep ravines. The soil is a dark-colored loamy clay, such as is everywhere characteristic of lands underlaid by the *Loess*, but is admirably adapted to the growth of fruit, and might be made a pomological paradise, under the management of those who know how to improve the favorable conditions which the hand of nature has so bountifully supplied. This portion of the county was originally covered with a heavy growth of timber, consisting of the usual varieties of oak, hickory, wild-cherry, etc.

Between Jerseyville and Fieldon the surface is comparatively level, and the timber consists of the usual varieties of oak, hickory, ash, elm, linden, cherry, honey-locust and black walnut; and the

valleys of the streams afford, in addition to these, cottonwood, sycamore, white and sugar maple, coffee-nut, hackberry, pecan and white walnut.

That portion of the county east of Jerseyville is underlaid by the Coal Measures, and is comparatively level, except the region traversed by the Piasa, where the surface is broken into sharp ridges, some of which are a hundred feet or more above the bed of the creek. The prairies are generally small, and are restricted to the northeastern part of the county. They are covered with the deep black soil so characteristic of the prairies in Central and Northern Illinois; and in their productive qualities they are not surpassed by any other portion of the State. As an agricultural region, this county ranks among the best; and, taking into the account its proximity to the great rivers, its prospective railroad facilities, its varied and rich mineral resources, it must commend itself at once to the attention of those seeking a home in this State, as one of the most attractive and promising locations to be found. Fine springs of water are abundant in the limestone region; and good wells are obtained on the prairies at a depth of from twenty to forty feet. It is one of the finest wheat-growing counties in the State; and, from the varied character of the surface, it is adapted to the growth of all kinds of cereals and fruits that can be grown in this latitude. The broken lands in the vicinity of the river bluffs are well adapted to grape culture: and, if in the hands of skillful vine-growers, could be made to yield a more liberal return for the labor required to cultivate them than can be obtained from the richest prairie lands in the county, planted with the common cereals grown in this climate.

I cannot close my report on this county without acknowledging my obligations to Dr. R. D. Farley and Mr. William McAdams, Jr., for valuable assistance and important information in regard to some of the most interesting and important points in the county, and also for many acts of personal kindness and hospitality which I received at their hands while prosecuting my labors in this county. The State Cabinet is also indebted to them for several rare specimens, which they generously donated from their private cabinets.

CHAPTER III.

GREENE COUNTY.

This county lies immediately north of Jersey, which forms its southern boundary, and is bounded on the west by the Illinois river, on the north by Scott and Morgan counties, and on the east by Macoupin county. It has a superficial area of about fifteen townships, or five hundred and forty square miles. It is well timbered and well watered, having, in addition to the river which forms its western boundary, Apple and Macoupin creeks, which, with their tributaries, traverse the county from east to west. Fine springs are also abundant along the river bluffs, and throughout the limestone region generally; and good wells are usually to be obtained on the uplands, at depths varying from thirty to forty feet.

The surface of the county is generally rolling; and the western portion, in the vicinity of the river bluffs, is quite broken and hilly, the valleys of the small streams being excavated to the depth of from one to two hundred feet below the general level of the uplands. In the central and eastern portions of the county the depressions of the valleys are considerably less, seldom exceeding fifty or sixty feet below the general level. The prairies are small; and the county has an abundant supply of timber, of the same varieties observed and noticed in the report on Jersey county. The bluff lands are well adapted to the cultivation of fruit, as well as wheat and the cereals generally; and, in point of soil and agricultural capacities, this county is not much behind the adjoining county of Jersey; and the general remarks made with regard to the latter county, may be applied with equal propriety to this.

The completion of the St. Louis, Jacksonville and Chicago Railroad through this county, gives additional facilities for the cheap and rapid transportation of its agricultural products to market, for

which it has heretofore been entirely dependent on the navigation of the Illinois river; and it will add materially to the value of the farming lands in the county, and to the general wealth and prosperity of its inhabitants.

General Geology of the County.

The geological features of this county are by no means so varied as those presented in the adjoining county of Jersey, for the reason that the disturbing influences that have elevated the Devonian and Silurian beds above the surface, in that county, did not extend into this; and consequently we find no beds exposed here below the lower Carboniferous limestones. The following vertical section of the several formations in the county will illustrate their general thickness and relative position:

Quaternary deposits, *alluvium, loess and drift*	100 to 120 feet
Coal Measures	150 to 160 "
St. Louis limestone	8 to 40 "
Keokuk limestone	100 to 125 "
Burlington limestone	120 to 150 "
Kinderhook group (partial exposure)	50 to 60 "

Alluvium.—The principal alluvial deposits in this county are those forming the bottom lands on the Illinois river, comprising a belt from three to five miles in width, and extending the whole length of the county from north to south. These lands are exceedingly fertile, and are among the most valuable and productive farming lands in the county. The greater portion of these bottom lands are prairie, sufficiently elevated to be susceptible of cultivation, and exceedingly productive. Adjacent to the river bluffs they are elevated entirely above high-water mark, and are not subject to overflow from the annual river floods. Belts of heavy timber occupy some portions of these bottom lands, and skirt the small streams by which they are intersected. The varieties of timber observed in this county are the same that have been enumerated in the preceding chapter as occurring in Jersey county.

Loess.—This formation is usually confined to the vicinity of the river bluffs, which it caps to the depth of from forty to sixty feet, and gives origin to the bald grassy knobs, which form so notable a feature in the topography of the bluffs, both on the Illinois and the Mississippi. It is largely composed of beds of marly sand, which sustain a thick growth of wild grass, and occasionally a stunted growth of oak. It is unconformable to the drift clays below it, and presents its greatest thickness immediately at the river bluffs, grow-

ing thinner toward the highlands of the adjacent region. It has been formed in the quiet waters of the lakes which once occupied the present valleys of the Illinois and the Mississippi rivers.

These marly beds of loess form an admirable sub-soil, being sufficiently porous to allow a thorough drainage; and, where they underlie a gently rolling or tolerably level surface, they form a quick, warm and very productive soil.

Drift.—Soft fine sections of drift were seen in the bluffs of Bear creek, below Blanchard's coal bank, of forty to fifty feet in thickness. The lower part was composed of bluish-colored clays, with small pebbles, and the upper part of the common reddish-brown clay, so generally characteristic of this formation. Large boulders of metamorphic rocks are not so abundant in the drift of this region as in many other portions of the State, but a few were seen of moderate size, composed of green-stone, porphyry and granite, giving unmistakable evidence of their northern origin. Specimens of drifted copper and galena are also occasionally found in the clay and gravel beds of this region, which cover the whole surface of the county, except the valleys of the streams. These have been transported also from the north—the copper from Lake Superior, and the galena from the lead region of northern Illinois or Wisconsin, and were transported at the same period and by the same agency that brought the boulders of metamorphic rock.

Coal Measures.—The Coal Measures of this county comprise about a hundred and fifty feet in thickness of sandstone shales, and thin bands of limestone, including three seams of coal, and comprise all the strata from the horizon of Coal No. 5 to the base of the measures, as they are developed in this portion of the State. The subjoined general section, compiled from many local sections in various parts of the county, will show their general thickness and relative position:

Compact brown limestone	2 to 4 feet
Bituminous shale	1 "
Coal No. 5	6 "
Shaly clay and nodular limestone	3 to 4 "
Shale	15 to 20 "
Bituminous shale	2 to 3 "
Coal No. 3	2 to 3 "
Arenaceous shales and sandstone	25 to 30 "
Bituminous shale, passing to Coal No. 2	2 to 3 "
Sandstone and shale	40 to 50 "
Coal—Tulison's and Nettle's Coal No. 1	2 to 3 "
Nodular steel-gray limestone, sometimes replaced with fire-clay, as at Tulison's	4 to 6 "
Shale and sandstone, passing locally into conglomerate	15 to 20 "
	153 feet

The only outcrop of coal No. 5 that was met with in this county is on the northeast quarter of section 36, township 10, range 10, just on the county line between Greene and Macoupin, in the bluffs of Hodges creek. This bank was owned and worked in 1864 by Thomas Rice, and the seam is here very variable in its thickness, ranging from four to seven feet. The upper part of the seam is considerably mixed with sulphuret of iron, and is only fit for steam purposes; but the middle and lower portions afford a good smith's coal. The seam at this locality dips to the eastward; and this may probably be considered as its most westerly outcrop. There are only a few inches of shaly clay separating this seam from the nodular argillaceous limestone below, exhibiting here the phenomenon of a heavy seam of coal directly inclosed between beds of marine limestone. The nodular limestone below the coal abounds in fossils at this locality, among which a massive coral, the *Chætetes milliporaceous*, is most conspicuous. This coral is generally hemisperical in form, and often attains a diameter of six to twelve inches. The limestone also contains many univalve shells belonging to the genera *Naticopsis*, *Pleurotomaria*, *Loxonema*, etc. Several species of these beautiful shells, from this locality, are figured and described in the second volume of the original report. The limestone which forms the roof of the coal is a compact bluish-gray rock, which weathers, on exposure, to a rusty-brown color, and contains *Productus longispinus*, *Spirifer lineatus*, *Fusulina*, and joints of *Crinoidea*.

Below this coal there is another seam that outcrops on the creek in this vicinity. It has not yet been worked to any extent, and no good exposure of it was seen, but it is reported to be about two feet in thickness.

Bassett's coal, on the southwest quarter of section 27, township 10, range 11, is about eighteen inches in thickness; and the coal is overlaid, first, by three or four feet of bituminous shale, and this by a limestone septaria, four feet or more in thickness. The coal is underlaid by a blue clay shale, from four to six feet thick, and this by a brown sandy shale, passing into sandstone, which outcrops down the creek for a distance of half a mile or more, and shows a thickness, altogether, of twenty-five or thirty feet. This seam probably overlies the coal at Tuilson's, on Wolf Run, as well as that on Birch creek; but, as they were not met with on the same stream, that point could not be positively determined. I am inclined to believe that it represents coal No. 2 of the general section. The coal in this seam appears to be of good quality, but it is too thin to be profitably mined at the present time. At many points there

is a heavy bed of sandstone intervening between this seam and the coal on Brush creek; and a similar bed, though perhaps a higher one in the series, is well exposed in the bluffs of Macoupin creek, at Rock bridge. The exposure here is from thirty-five to forty feet in thickness, the lower part consisting of blue sandy shales, which are overlaid by a massive brown sandstone, passing upward into a brown sandy shale. The sandstone is partly concretionary in structure, the concretions being quite hard, and forming a durable building stone. On Birch creek a similar sandstone is well exposed, overlying coal seam No. 1, with a thickness of twenty-five to thirty feet.

Nettle's coal-bank is on the northeast quarter of section 25, township 12, range 11, about eight miles northeast of Whitehall. The coal averages about three feet in thickness, and is overlaid by from three to five feet of bituminous shale, which forms a good roof to the coal. Above the shale there is a bed of massive sandstone, twenty feet or more in thickness, similar to that at Rock bridge. Under the coal there is a bed of shaly clay, not more than a foot or two in thickness, which rests upon a hard, steel-gray, nodular limestone, about four feet thick. These beds outcrop along the creek for a distance of about three miles above Nettle's place, the fall of the creek being just about equal to the dip of the coal, and in the same direction, which is to the southeast.

On Wolf Run, about a mile and a half east of Whitehall, a seam of coal outcrops along the creek for a distance of a mile or more, and has been opened at several points. It is from two feet to two and a half in thickness, and is a clear, bright coal, breaking in regularly shaped blocks, and quite free from sulphuret of iron. It is overlaid by about two feet of bituminous shale, which passes upward into a blue clay shale, which is overlaid by sandstone. Below the coal there is an excellent bed of fire-clay, from eight to ten feet thick. The upper openings on this creek are on the lands lately owned by David Rankin, and the lower one is on the lands of Isaac Tulison.

On the southeast quarter of section 36, township 11, range 12, about four miles northeast of Carrollton, a coal seam has been opened on the west fork of Whitaker's creek, which, with the associated rocks, forms the following section:

Coal Measures—

Brown sandy shale	10 to 12 feet
Bituminous shale	2 "
Coal	1½ "
Shaly clay, passing downward into sandy conglomerate	10 to 15 "

Band of iron ore	1½ feet
Hydraulic limestone	4 to 6 "
Keokuk limestone	15 to 20 "

The beds above the band of iron ore in this section belong to the Coal Measures, and those below to the lower Carboniferous limestone. It will be observed, in this section, that the St. Louis limestone, upon which the Coal Measures usually rest in this county, is not represented, unless it be by the bed of hydraulic limestone. The Keokuk limestone is well marked, presenting the usual characteristics that distinguish it at other localities. The iron ore above the hydraulic limestone is an earthy, brown hematite of good quality. The coal seam is only about eighteen inches in thickness, and the work of mining it appeared to have been temporarily suspended. This coal has been opened on the east fork of Whitaker's creek, and also on Bear creek, on Mr. Blanchard's place, about a mile and a half above the mouth of the creek.

Blanchard's coal bank is on the northwest quarter of section 14, township 11, range 11. The coal varies in thickness from two to three feet, and is overlaid by bituminous shale and massive sandstone. This seam appeared to be the same at Nettle's coal, on Birch creek. A mile and a half below Blanchard's the St. Louis limestone is to be seen in the bluffs of the creek; but the intervening beds between the coal and the limestone are not exposed. In sinking the well for the steam mill at Carrollton, a thin seam of coal, about six inches thick, was said to have been passed through at a depth of about seventy feet below the surface. Although the Coal Measures underlie nearly all of the eastern half of the county, they comprise only the horizon of the lower coal seam, over a considerable portion of this area; and, along the extreme western borders of the coal field, even this is too thin at many localities to be worked to advantage, and the eastern range of townships must be mainly relied on for a supply of coal. The measures in this county comprise the whole range of the productive Coal Measures, as they are developed in this portion of the State; but the main seam, No. 5, only extends a little over the eastern line of the county, and consequently underlies but a very small area in this county, while the lower part of the measures, which underlie all the eastern portion of the county, only have two of the four lower seams developed, and these range in thickness from eighteen to thirty-six inches. Hence Greene county is not as well supplied with coal as either Jersey or Macoupin; and the principal deposits are confined to the eastern portion of the county. The seam at Nettle's mine, on Brush creek,

and at Blanchard's, on Bear creek, I regard as probably the same as the Exeter coal, in Scott county, and Tulison's bank, two miles northeast of Whitehall, may be referred to the same horizon. Burrows' coal probably holds a higher position, and perhaps represents either No. 2 or 3 of the general section of the Coal Measures in Central and Northern Illinois.

St. Louis Limestone.—This formation is quite variable in this county, both as regards its thickness and its lithological characters. On Link's branch, south of Carrollton, and about a half mile east of the State road from Carrollton to Jerseyville, a fine quarry has been opened in this limestone, on the lands of Mr. Joseph Stohr. The thickness of the rock at these quarries is about fifteen feet; and the lower ten is a heavy bedded magnesian limestone, some of the layers being from two to three feet thick. The prevailing colors are light yellowish-gray and brown; and these colors often replace each other in the same stratum. The rock is even-textured, free from chert or other siliceous material, and dresses easily; and these quarries afford most of the cut stone used at Carrollton. The lowest strata seen at these quarries appeared to be a hydraulic limestone, and was about eighteen inches thick. At the crossing of the State road, a half mile further up the creek, the rock is not so even-textured, some of the strata being too hard to dress readily, and others too soft to stand exposure to the atmosphere. The whole thickness of the beds exposed, from the State road to Stohr's quarries, may be estimated at from twenty-five to thirty feet. In the upper part of this group, near the State road, there is also another stratum of what appeared to be a hydraulic limestone, about two feet thick.

On the road from Carrollton to Turpin's mill, this limestone is found outcropping in the beds of the small creeks that empty into the Macoupin. Turpin's mill is on section 16, township 9, range 11; and the St. Louis limestone is found well exposed on a small branch about a quarter of a mile west of the mill. The lower part of the bed, as it appears at this locality, is a brown arenaceous limestone, while the upper is of a gray and mottled color, and sufficiently pure to be burned for lime, though not a very good material for that purpose. The entire thickness of the beds exposed here is only about fifteen feet.

At Thompson's mill, on the northeast quarter of section 10, township 11, range 11, there is an exposure of about twelve feet of this formation. The upper four feet is a brown magnesian limestone, and the lower eight feet an earthy, grayish-brown hydraulic lime-

stone, exactly resembling in appearance the hydraulic layers of this formation at other localities. This is the thickest bed of this kind of rock found in the county; and, if it should prove on trial to be as good a hydraulic rock as its appearance would indicate, it will become valuable for the manufacture of cement. It is no doubt the equivalent of the hydraulic limestone noticed at the coal mine on the west fork of Whitaker's creek, and is here nearly twice as thick as at that locality. Fossils are quite scarce in this formation, at nearly every locality examined in this county. Some interesting forms of *Bryozoa* were obtained at the quarries on Link's branch, and we saw, in the cabinet of Dr. FARLEY, of Jerseyville, a fine specimen of *Conularia*, probably *C. Missouriensis*, that was found at this locality.

Keokuk Limestone.—This formation, with the overlying St. Louis limestone, occupies a belt immediately beyond the western borders of the Coal Measures, and intervening between them and the Burlington limestone in the vicinity of the river bluffs. This belt is from three to four miles in width; and the Keokuk limestone, which forms the greatest portion of it, outcrops on the tributaries of Macoupin and Apple creeks, and on the last named creek itself, a half mile below the bridge, on the main road from Carrollton to Whitehall.

On the small creek, a half mile south of Whitehall, the upper part of the Keokuk limestone is found outcropping for a distance of a mile and a half or more on either side of the creek. The rock is here a thin-bedded, cherty, gray limestone, with thin partings of calcareo-argillaceous shale. It seldom affords strata more than six inches thick, and is therefore not a desirable building stone, except for light walls. It affords some characteristic fossils at this locality, among which are *Archimedes Owenana*, *Platyceras equilatera*, *Agaricocrinus Americanus*, *Productus punctatus*, *Spirifer cuspidatus* and *S. Keokuk*. The fossils of this formation are not so numerous or so well preserved at the localities examined in this county as they are in the same beds in Jersey county.

On the west fork of Whitaker's creek, these same beds are exposed between the coal bank and the mouth of the creek, and afford the same varieties of fossils obtained in the vicinity of Whitehall. On Apple creek, a short distance below the bridge on the Carrollton and Whitehall road, the lower beds of this limestone are exposed, affording layers from twelve to eighteen inches thick. No point was found in the county where the whole of this formation could be seen in a single section; and, for a general description of its char-

acteristic features, as well as the determination of its thickness, we have relied upon the results of local examinations of such portions of the formation as could be found exposed in different parts of the county. We have estimated its thickness, approximately, at one hundred to one hundred and twenty-five feet; but it may be somewhat greater, even, than that.

Burlington Limestone.—The outcrop of this formation is confined to the western part of the county. It forms the main portion of the river bluffs throughout the whole extent of the county, from north to south, and extends eastward from the bluffs, forming a belt from three to four miles in width. At the south line of the county, where Macoupin creek intersects the river bluffs, the lower part of this limestone, about seventy feet in thickness, forms the upper part of the bluff, and is underlaid by fifty-four feet of the ash-colored shaly limestones of the Kinderhook group. From this point to the north line of the county, this limestone is seen in a continuous exposure, except where intersected by the valleys of the small streams; and it often presents mural cliffs of limestone along the face of the bluffs, from seventy-five to a hundred feet in height.

At James J. Eldridge's place, the limestone measures a hundred feet in thickness above the road at the foot of the bluff, and is capped by a mound of loess sixty feet high; and the bluffs very generally culminate, in this vicinity, in bald knobs, covered only with grass, giving a very picturesque outline to the landscape. The limestone at Eldridge's place is a light gray crinoidal rock, in quite regular beds, with comparatively but little cherty material, and forms an excellent building stone, which is extensively used not only at this locality, but by the wealthy farmers occupying the bottom lands at the foot of these bluffs throughout the county, for dwellings and barns, and also for fences. About half a mile below the county line between Greene and Scott, the limestone bluffs are about one hundred feet high, and are capped with forty feet of loess.

At this point there is a bench of brown limestone, projecting a few feet beyond the face of the bluff, and only a few feet above the base, that is covered with rude figures cut upon the surface of the limestone by some of the aboriginal inhabitants of this country. Among these figures are the outlines of a human foot, and also that of a bear, several that were evidently intended to represent the tracks of birds, and others that do not appear to represent any natural object, but seem rather designed to record, in hieroglyphics, some historic or mythological events. These figures were cut upon the surface of the stone with some hard instrument, to the depth of

perhaps one-sixteenth of an inch. The surface of the stone on which they were engraved, has been worn almost as smooth as glass, probably by the tread of human feet.

The bluffs of the Illinois and the adjacent bottoms appear to have been favorite resorts of some of the primeval races; and their rude antiquities, consisting of stone axes and knives, discs, flint arrow-heads, and an instrument resembling a mason's plummet, made apparently from the compact iron ore of the Iron Mountain in Missouri, are quite common in the counties of Greene, Jersey and Calhoun.

Fossils are not very numerous in the Burlington limestone, at the localities we examined in this county; but the following species were obtained: *Spirifer Grimesi, S. Forbesii, Athyris incrassata, A. lamellosa, Productus punctatus,* and *Actinocrinus concinnus.*

Kinderhook Group.—The upper half of this formation, including a thickness of about fifty feet, may be seen at the point where the Macoupin intersects the river bluffs; and this is the only exposure of the bed that we have met with in the county. So far as could be seen, it consisted of ash-colored shales and shaly limestone, and afforded no fossils at this locality. Above this point, its outcrop along the bluff is hidden by the talus from the overlying beds.

Economical Geology.

Coal.—About one-third of the entire surface of the county is underlaid by the Coal Measures; and they include the horizon of three or four coal seams, though but two of these appear to be mined at the present time to any considerable extent. The upper one, No. 5, is only found along the east line of the county, on Hodges creek. It underlies but a very limited area in this county, and the exposures above named are probably nearly or quite on the western limit of its outcrop. We did not see it on Apple creek, but its line of outcrop would indicate that it might be found on that stream, in the vicinity of Athens. The two lower seams are comparatively thin, and nowhere exceed about three feet where they have been examined in this county.

No. 5 varies in thickness in this county from four to seven feet, while the lower seams, of which there are three, vary in thickness from one and a half to three feet. The two lower seams will probably be found to underlie nearly all the eastern portion of the county; and they will afford an abundant supply of coal for home consumption. The seam that outcrops on Birch creek is probably

the same as that on Tulison's land, near Whitehall; and it may be mined at almost any point in the eastern part of the county, at a depth varying from fifty to one hundred and fifty feet below the surface. Where it is desirable to mine it at a point where it does not outcrop at the surface, a boring should first be made to ascertain the thickness of the coal and its depth below the surface; and, when these points are determined, an exact calculation can be made of the expense of opening the mine, and the amount of coal it will afford to a given area. The expense of boring ought not to exceed two dollars per foot for the first one hundred and fifty feet. On Wolf Run and on Birch creek, where the lower seam is exposed, it will average two feet and a-half in thickness, and will yield two and a-half million tons of coal to the square mile. It is the same as the Exeter coal, in Scott county, and the coal it affords is generally better than the average quality, being quite as free from sulphuret of iron, in this county, as No. 5. The seam at Bassett's, on the southwest quarter of section 27, township 10, range 11, appears to be of a local character, and can not be relied on as a productive bed, over a large area of surface. It was not met with anywhere else during our examinations of the county.

Clays.—The best clay for the potter's use, and for fire-brick, is the bed under the coal seam on Wolf Run. At some points this clay is from eight to ten feet thick, and outcrops at the surface, at many localities, from one and a-half to three miles from Whitehall. The thickness of this bed, and its proximity to the railroad, make this one of the most valuable deposits of potters' clay known in the State; and the near proximity of excellent coal, which may often be mined in the same drift with the clay, makes this one of the most desirable points for the manufacture of fire-brick or pottery, on a large scale, that can be found in the State. At Blanchard's mine no exposure of the clay under the coal is to be seen; and on Birch creek the coal-seam is underlaid by limestone, below which the beds were not seen; but in the vicinity of Winchester, and at some other localities in Scott county, the limestone below this coal is underlaid by a thick bed of nearly white clay, almost exactly like that east of Whitehall; and it is quite probable a similar clay may be found underlying the limestone on Birch creek.

Paint Clays.—At Mr. Charles J. Carter's place, two and a-half miles southwest of Woodville, there is a local deposit of paint clays underlying the true northern drift, and yet bearing no apparent lithological relation to the rocks on which they rest. The deposit at this point consists of red, yellow and white clays, attaining a thick-

ness altogether of about eight feet, and they are intercalated between the boulder drift and the geodiferous shales of the Keokuk limestone.

In composition they are quite unlike any of the rocks with which they are now associated, and they have probably been derived from shaly beds of stratified rocks more recent than the lower Carboniferous limestone on which they rest. The upper part of the deposit is a bed of white clay from four to six feet in thickness, and below this, beds of red and yellow clays occur. They have been thoroughly tested by Mr. Carter and others, and have proved to be well adapted to form a cheap paint for outside walls, and a number of different shades of color may be produced by adding a small and variable amount of Prussian blue.

Similar deposits of paint clays occur in various portions of the State, though of limited extent, and have all probably been derived from some common source. It is quite probable that they have originated from outliers of cretaceous shales, that, anterior to the Drift epoch, occupied depressions in the older rocks far beyond the present boundaries of that formation in the west, and, I have no doubt, once covered considerable areas in this State, and were broken up and partially carried away by erosive agencies anterior to the deposit of the boulder drift, while the residuum was re-deposited in the depressions of the limestone floor in the form of fine siliceous clays. This theory will also explain the occurrence of cretaceous fossils in the superficial deposits of this and the adjacent States, such as sharks' teeth, fragments of *Ammonites*, *Belemnites*, and other cretaceous forms which are sometimes met with in our gravel beds, or in the alluvial deposits of the streams, in such a state of preservation as would preclude the assumption that they had been transported from remote points by the ordinary drift agencies of ice and water.

These deposits of paint clays are of considerable local value, as they furnish a cheap and durable paint for common use.

Hydraulic Limestone.—The St. Louis limestone affords some layers that seem to possess hydraulic properties, at several localities in this county, though they are generally rather too thin to be of much value at the present time. The thickest bed seen in the county is at Thompson's mill, on Apple creek, where it is about eight feet in thickness. This locality would afford a sufficient amount of material to justify the erection of a cement mill at this point, should the rock prove, on trial, to be as well adapted to this purpose as its appearance would indicate.

Iron Ore.—On the west fork of Whitaker's creek there is a seam of iron ore underlying the coal at that locality, about eighteen inches in thickness. The ore is a hematite of a dark brick-red color, and appears to be of a good quality. Coal and limestone, for reducing it to metallic iron, are abundant in the vicinity of the ore.

Limestone for Lime.—The best material for this purpose, that we met with in this county, is that afforded by the light gray semi-crystalline beds of the Burlington limestone, along the river bluffs. Some of these are a nearly pure carbonate of lime, and are not surpassed for this purpose by any limestone in the county. The lower part of the Keokuk limestone, as it appears below the bridge on Apple creek, will afford a very good limestone for this purpose; but the St. Louis group, which usually affords the purest limestone of all, affords no material adapted to this purpose at any of the localities we were able to examine in this county.

Building Stone.—All the principal limestone formations in this county afford good building stone for ordinary purposes; and some of them afford a superior article, suitable for cut-stone work and ornamental architecture. The most abundant supply, as well as the finest material of this kind, will be furnished by the Burlington limestone, which outcrops in the vicinity of the river bluffs. The rock is tolerably even-bedded, in strata varying from six inches to two feet in thickness, and can be very easily and cheaply quarried; so that it is now used, not only for all the ordinary purposes for which a building stone is required, but also for fencing the farms along the foot of the bluffs. Several elegant farm-houses have already been built in this county from this material; and, as the wealth of the country increases, something like a correct taste in architecture will obtain among the people, and a desire for more substantial and elegant buildings will be the result. This will give increased value to our supplies of fine building stone; and quarries that are now reckoned of little value to the owners, will eventually become sources of wealth to an extent that cannot at present be realized.

The St. Louis limestone will perhaps rank next in value for supplying the wants of the citizens of this county with good building stone. The quarries on Link's branch, near Carrollton, are capable of supplying the wants of that town and the surrounding country. The rock obtained at this locality is a yellowish-gray or brown magnesian limestone, soft enough to be cut with facility, when freshly quarried, and makes a fine building stone, either for cut-work or for heavy walls. Some of the beds are thick enough to furnish dimen-

sion-stone of a large size. At the present time (1864) the demand for this stone is limited to the vicinity of the quarries; but, when the railroad is completed to this point, this rock may be profitably furnished to distant and less favored localities. This bed will furnish a good material for heavy walls, at every locality where we saw it exposed in this county.

The Keokuk limestone will also furnish a very good building stone, wherever the lower part of the bed is found exposed. This portion of the bed affords layers of light bluish-gray compact limestone, from six inches to a foot in thickness, that may be used for all the ordinary purposes for which material of this kind is required. In the upper part of the bed the layers are thin and cherty.

The sandstone overlying the coal seam on Birch creek has all the characteristics of a reliable building stone. It is a massive, micaceous sandstone, containing considerable ferruginous matter, withstands atmospheric influences well, and forms a bold mural wall along the bluffs of the creek, from fifteen to twenty feet in height. It will furnish an abundant supply of building stone for this part of the county. On Bear creek, the sandstone is more unevenly bedded, and somewhat unevenly textured, some portions of it showing a disposition to crumble on exposure to the atmosphere. If quarried for building stone, where it presents this appearance, it should be selected with care; and the soft portions of the rock should be rejected. In a word, this county has an abundant supply of building stone, not only for the use of the inhabitants within its own borders, but also a large surplus for the supply of other portions of the State.

The agricultural resources of this county are very similar to those of Jersey county; and what we have said in relation to the soil and timber of that county would be equally applicable to this. The prairies are usually small; and all the streams are skirted with belts of excellent timber. Away from the river bluffs, the lands are generally level or gently rolling; and the soil is very productive. Corn and wheat are the great staples of this portion of the State; and the cultivation of these great cereals, and stock-raising, are the principal pursuits of the farmer. Since the completion of the railroad through this county, its market facilities are greatly increased, and the value of its rich farming lands correspondingly enhanced, since its products are made accessible to the best markets of the country, at all seasons of the year.

CHAPTER IV.

SCOTT COUNTY.

This county lies immediately north of Greene, which forms its southern boundary, and it is bounded on the west by the Illinois river, and on the north and east by Morgan county. It embraces a superficial area of about seven townships, or two hundred and fifty-two square miles. A broad belt of alluvial bottom lands, from three to four miles in width, skirt the shore of the Illinois river, and extend from north to south throughout the county. These bottoms are mostly prairie, with narrow belts of timber skirting the streams. The middle portion of the county is generally rolling; and some portions of it adjacent to the river bluffs are broken and hilly. The eastern portion is comparatively level, and is interspersed with small prairies. More than one-half of the entire surface of the county was originally covered with a heavy growth of timber, embracing the usual varieties already enumerated in the counties south of this.

The ancient valley, now occupied by the Illinois river and its alluvial bottoms, was originally much wider through a considerable portion of the county than it is at the present time, and was excavated through solid limestone strata, to the depth of more than a hundred feet. This valley originally extended considerably farther east than the present line of river bluffs, through that part of the county lying south of the *Mauvaisterre*, down to within about a mile of the south line of the county; and the limestone strata have been entirely removed by erosion, their place being now occupied by accumulations of loess and drift, which form the bluffs; and it seems probable that the original valley was nearly or quite twice as wide at this point as the present one. The date of this erosion can not now be determined, farther than to state that it occurred anterior

to the accumulation of the Quaternary formation, and subsequent to the deposit of the lower Carboniferous limestones.

In the vicinity of Moore's coal bank, on Sandy creek, we see unmistakable evidence of an erosion that must have taken place at a period anterior to the deposit of the Coal Measures, and subsequent to the formation of the lower Carboniferous limestones, because we find that the St. Louis limestone and the upper beds of the Keokuk limestone have been removed by erosive forces, and that the overlying Conglomerate of the Coal Measures is here made up in part of the fragments of the missing limestones, and rests unconformably on the *Archimedes* beds of the Keokuk series. It is perhaps impossible to determine at the present time whether or not these erosions of the limestone strata at the two localities cited are due to a single cause, and occurred simultaneously in time; but it seems quite probable that they did not, otherwise the coal-bearing strata should be found filling in part the ancient river valley in the place of the Quaternary. It seems more probable that they belong to two distinct and widely separated epochs, one of them dating back to the commencement of the Coal period, and the other occurring much later, but anterior to the accumulation of the Quaternary deposits, and simultaneous with the formation of the principal valleys in which our large rivers now run.

From the point where the limestones disappear in the bluffs, about one mile above the south line of the county, to the *Mauvaisterre* creek, the Quaternary deposits are the only formation exposed in the vicinity of the bluffs, and these fill the eastern portion of this ancient valley, as before stated, to the depth of from one hundred to one hundred and twenty feet. Where these heavy accumulations of Quaternary beds occur, the surface is cut up into somewhat abrupt hills and ridges, as is seen in the vicinity of Glasgow, and especially west and northwest of that town. These lands, however, possess an excellent soil, and were originally heavily timbered with white oak, hickory, ash, elm, walnut, sugar maple, linden, wild cherry, etc.; and, since they have been brought under cultivation, they prove to be among the most productive lands in the county. Wherever the land was originally covered with such a growth of timber as that just mentioned, there can be no question as to the superior quality and productive capacity of the soil; and these lands are really preferable, for most agricultural purposes, to the best prairie lands of the adjacent region.

In the geological structure of this county we find but a slight variation from that presented by the adjoining county of Greene;

and a general section of the strata will be found to present only this difference, that the Kinderhook group will be wanting at the base, and a few feet in thickness of Coal Measures near the top, cutting off coal No. 5 and its associated strata.

The following section will show the relative thickness and order of superposition of the strata in this county:

Quaternary	100	to	120	feet
Coal Measures—				
Sandstone and shale	20	to	40	"
Band of limestone			2	"
Bituminous shale—Coal No. 2?	2	to	3	"
Sandstone and shale	30	to	40	"
Bituminous shale	1	to	4	"
Coal (Exeter seam) No. 1	2½	to	3	"
Dark-blue clay shale	2	to	3	"
Compact, dark-blue limestone	3	to	4	"
Light-gray clay shale, or potters' clay	10	to	12	"
Shaly sandstone and conglomerate, with bands of iron ore, and locally a thin seam of coal	6	to	15	"
Lower Carboniferous Limestone—				
St. Louis limestone	20	to	40	"
Keokuk limestone	75	to	100	"
Burlington limestone	100	to	120	"

The Quaternary deposits in this county present the same general features as those noticed in the report on the adjoining county of Greene, and it is therefore unnecessary to repeat them here. The loess caps the river bluffs, and often reaches a thickness of forty to sixty feet, forming bald, grassy knobs along their summits.

Coal Measures.—The strata belonging to the Coal Measures in this county have an aggregate thickness at their outcrop of about one hundred and thirty feet, and include the horizon of two or three coal seams, only one of which, however, promises to be of any considerable value here. The sandstone overlying the Exeter coal outcrops on all the streams in the eastern portion of the county, and the full thickness of the measures above this seam may be estimated at from eighty to ninety feet. This thickness includes a bed of bituminous shale, which probably represents the horizon of the Burrows coal, in Greene county, and perhaps also the Neelyville coal, in Morgan county. Those desirous of mining the Exeter coal, in the east part of the county, will have to sink a shaft through these sandstones, and also the overlying drift, which will comprise a variable thickness of from seventy-five to two hundred feet of strata. On a small branch east of Manchester we found the upper sandstone represented in the foregoing section well exposed, including the upper bituminous shale. The measures here consist of about thirty or forty

feet of sandy shale, with a single stratum of hard, micaceous sandstone, about a foot in thickness. There was also a partial exposure of a band of limestone, underlaid by bituminous shale.

The Exeter coal has been opened at various points along the line of outcrop in this county. Tuft's coal mine is on the Big Sandy, two miles east of Winchester. The coal is here about three feet in thickness, with a good roof of bituminous shale, from three to four feet thick. It is underlaid by shaly clay, from two to three feet thick, and also by the steel-gray, nodular limestone already mentioned as underlying this seam on Birch creek, in Greene county. Below this limestone there is a bed of potters' clay, from ten to twelve feet in thickness. This clay closely resembles that on Wolf Run, in Greene county, and probably holds the same stratigraphical position. Traces of a thin bed of sandstone were seen, along the banks of the Big Sandy, that seemed to underlie the potters' clay, and to rest on the St. Louis limestone.

At Moore's coal mine, on the Little Sandy, formerly known as Frost's mine, the following beds are exposed in connection with the coal seam:

Sandstone and sandy shale	8 feet
Bituminous shale	3 "
Coal	2 to 3 "
Shaly clay	3 "
Nodular limestone	4 to 5 "
Clay shale, or potters' clay	10 to 12 "
Conglomerate, containing geodes, etc	6 to 10 "
Shale, with bands of iron ore	4 "
Keokuk limestone	10 to 15 "

In this section it will be observed that the St. Louis limestone, on which the Coal Measures usually rest in this county, is absent, and has no doubt been removed by erosion before the deposition of the Coal Measures. The Conglomerate, which forms the base of the Measures at this locality, is composed of sand, fragments of limestone from the St. Louis group, and geodes from the upper part of the Keokuk limestone, all intermingled together, and cemented with ferruginous matter. In some portions of the Conglomerate at this locality, the siliceous geodes peculiar to the Keokuk limestone are as thickly embedded as they are in the geode bed itself when most perfectly developed; and the bed appears to be formed, in good part, at least, from the debris of the St. Louis and Keokuk limestones. The Conglomerate, with about four feet of shale that may be said to form its base, rests directly upon thin-bedded limestone, containing *Archimedes Owenana*, *Platyceras equilatera*, *Barycrinus stellatus*, and *Productus semireticulatus*. One geode from the Conglom-

erate at this locality was found to be entirely filled with sand, which had been converted into sandstone. Another was found with the cavity partly filled with brown oxide of iron, that had no doubt filtered into it after it was inclosed in the Conglomerate.

The coal seam at this locality, which has been worked for many years, is reputed to be the best smith's coal in this part of the State. This reputation was acquired while in the possession of the former owner, Mr. Frost, who had the good sense to separate the coal from the upper part of the seam, which is quite free from iron pyrites, from that below, and to sell that exclusively for blacksmith's use. In this way he made a reputation for his coal that insured the sale of it to all the blacksmiths in this region, though the same seam had been opened at many other localities. The reputation of our Illinois coal has always suffered from the careless nanner in which it has been mined, the workmen putting into the "wagon," without scruple, along with the coal, the slate and sulphur balls that should always be carefully separated from the coal in mining, because it cannot readily be done afterward.

About a mile southwest of Moore's place, a coal seam has been opened in the bed of the creek, where it has been worked by "stripping," or removing the overlying beds of soil and gravel. This coal rests directly on the Keokuk limestone, with only a foot or two of shaly sandstone between, and occupies the same horizon with the shale and iron ore bands in the section at Moore's. The nodular limestone under Moore's coal crops out in the hillside at this locality about fifteen feet above the level of the lower coal. The pit was partially filled with water, so that the thickness of the coal was not accurately measured; but it is probably from two to two and a half feet. This is no doubt a purely local deposit, representing what is known at more southern localities as the Conglomerate coal. Thin layers of shaly sandstone, with *Stigmaria*, were seen in the debris of the creek, that appeared to have come from under the coal. This coal has not been met with at any other localities in the county.

The Exeter seam, in the vicinity of that town, varies from two feet to two and a half in thickness, and is sometimes underlaid by the steel-gray nodular limestone, already noticed at other localities, as is the case at Neeley's place, a half mile northwest of Exeter; and at other points, as in the immediate vicinity of the town, there is only a shaly clay, from two to four feet in thickness, between the coal and the St. Louis limestone. The roof at Neely's mine is a hard bituminous slate, passing locally into a cannel coal. It

contains great numbers of *Discina nitida*, and more rarely *Lingula mytiloides* and *Productus longispinus*.

About twenty-five or thirty feet above the Exeter seam is the Neeleyville coal, which is extensively worked at Neeleyville, in Morgan county, near the north line of this county, but is rarely, if at all, developed in this or the counties immediately south of this, on the east side of the Illinois river. At Neeleyville, a shaft was sunk from the upper to the lower seam, showing the distance between them to be about thirty feet. The upper or Neeleyville coal is probably the equivalent of coal No. 2 of the general section, and, in many portions of the State, is quite uniform in its development. Although the horizon of the Neeleyville seam has been found exposed at many localities in Scott and Greene counties, yet no bed of bituminous coal has been seen that could be identified with it, unless it is the equivalent of the Burrows coal in Greene county.

The section of the Coal Measures in this county includes the horizon of three coals that are developed in some of the counties on the west side of the river, of sufficient thickness to be worked with profit; but we saw no evidence of the development of any but the lower seam here, though it is quite possible that one of the others may be found in the eastern part of the county, where there are now no natural exposures of the strata.

St. Louis Limestone.— This limestone is the fundamental rock on which the Coal Measures rest at every locality examined in this county, except that at Moore's coal mine, on Little Sandy. About one mile southeast of Winchester, it is well exposed on a small branch of the Big Sandy, where it is overlaid by the Conglomerate. The exposure at this locality affords the following section:

Conglomerate sandstone	10 to 12 feet
Gray limestone	3 to 4 "
Thin-bedded greenish-gray sandstone	3 "
Massive brown magnesian limestone, with some thinner beds of hydraulic limestone	27 "

The Conglomerate at this locality appears to be only a local development, or an outlier form of the adjacent Coal Measures. The gray limestone that forms the upper bed of the St. Louis series, at this locality, has been quarried and burned for lime. The brown magnesian beds below are quite massive, some of the layers being two feet or more in thickness. They contain numerous fossils, among which are *Rhynchonella mutata*, *Retzia Verneuliana*, *Productus Altonensis*, *Spirifer lineatus*, and *S. Keokuk*, with several undetermined species of *Bryozoa*. On the Big Sandy, in the vicinity of Winchester, this formation is well exposed, and is a regularly

bedded gray limestone that makes a durable building stone, and is also burned for lime. The upper portion of the bed is generally calcareous in this vicinity, while the lower part is generally arenaceous and magnesian, and contains local intercalations of true sandstone. At Exeter, the limestone exposure is from twenty to twenty-five feet in thickness, and consists of alternations of gray, compact limestone, with beds of brown magnesian rock, which pass locally into an earthy, buff-colored, hydraulic limestone. A half mile west of Exeter, the magnesian beds contain geodiferous cavities lined with crystals of dolomite. There are also some intercalations of green and brown shaly layers in the limestone at this locality. Along the bluffs of the river, from a point half a mile above where the Exeter and Naples road intersects them to the north line of the county, this limestone is exposed at short intervals. It is very variable in its lithological character, in this part of the county, and consists of alternations of sandstone and limestone, which seem to replace each other at short intervals. About half a mile above the road just mentioned, an exposure of only about six feet in thickness was to be seen, consisting of a regularly-bedded greenish-gray sandstone, some layers of which appeared to be somewhat calcareous, and contained casts of *Rhynchonella*, and some other shells. It appeared to be a good building stone. A half mile above this, a massive gray and brown coarse-grained limestone was seen, from twelve to fifteen feet in thickness, and apparently occupying the same horizon as the sandstone at the other locality. The rock has a concretionary structure, and presents no regular lines of bedding, but splits with considerable regularity in either direction, and makes a good building stone. It contains some fossils; and we obtained at this locality *Productus ovatus*, *P. tenuicostus*,* *Spirifer Keokuk*, with two or three species of fish-teeth. It is overlaid by about eight feet of shaly limestone, without fossils. At Henry Smith's place, scarcely a half mile above the locality just described, extensive quarries have been opened for building stone. The rock is here mainly an even-bedded greenish-gray sandstone, with some thin layers of magnesian limestone, and is an excellent building stone. A half mile below Bluff City, a similar rock has been quarried for the construction of culverts on the railroad. At this point the sandstone contains many fragments of plants, and resembles,

*This name was used by Prof. HALL, in the Iowa Report, to designate a form of *Productus* that is probably only a variety of *P. semireticulatus*. If it proves to be a distinct species, the name should be *tenuicostatus*.

and might be easily mistaken for, a Coal Measure sandstone. About a mile east of Bluff City, near Vangundy's, we find regular beds of gray limestone, belonging to the St. Louis series, outcropping in the bluffs of the creek, and presenting the usual characters of the calcareous beds of this formation. From what has been said of the various outcrops of this limestone in this county, it will be seen that it is exceedingly variable in its appearance and lithological characters; and if an observer was to meet with it for the first time in this county, he would most likely be somewhat puzzled by the peculiar features that would be presented for his examination; for we here find the commencement of certain lithological changes in the character of this formation, which, on the eastern borders of the coal-field, extend into the lower groups, and merge nearly the whole of the lower Carboniferous limestone series into green shales and shaly sandstone.

Keokuk Limestone.—The only exposure of any considerable portion of this limestone met with in this county was on the Little Sandy, where it directly underlies the Coal Measures. The rock at this exposure is quite thin-bedded and cherty; and not more than ten or fifteen feet in thickness was to be seen here. At the river bluff, on the Exeter and Naples road, there is an exposure of about thirty-five feet of calcareo-argillaceous shales, with geodes, which no doubt represent the upper part of this formation. About the middle of the bed, at this locality, there is a band of hard brown magnesian limestone, about two feet thick, which contains *Hemipronites crenistria*, *Spirifer Keokuk*, *Productus punctatus*, etc. These beds undoubtedly belong above those that outcrop on the Little Sandy. The lower part of this limestone we did not find exposed at any of the localities examined in this county.

Burlington Limestone.—A half mile above the south line of the county, on William T. Collin's place. there are about one hundred and twenty feet of this limestone exposed in the river bluffs; and it is overlaid by from fifty to sixty feet of loess. The limestone here presents its usual characters of alternating beds of light-gray and brown limestone, with some cherty material in seams and nodules. This limestone appears along the bluffs for about a mile above the Greene county line, when it disappears; and the mural bluffs, which it forms wherever it is found, give place to rounded hills of loess and drift. About half a mile south of Glasgow, this limestone is again seen on a small branch of the Big Sandy, in an exposure about fifty feet in thickness, where it presents the same general characters as at the locality first noticed. The upper part

of the mass is quite cherty here, and is comparatively worthless for economical purposes; but the lower part affords massive beds of gray and brown limestone of good quality. Fossils were more abundant at this locality than in the river bluffs; and we found the following species: *Spirifer Grimesi, S. plenus, Orthis Michilini, Athyris lamellosa, Actinocrinus Christyi, A. Verneuilianus, A. Missouriensis, A. multiradiatus,* and undetermined species of *Chateocrinus* and *Agaricocrinus.*

Economical Geology.

Coal.—More than one-half of the entire surface of the county is underlaid by the Coal Measures; and, although these measures only include the horizon of three seams of coal, only one of which appears to be developed over any considerable extent of surface, yet the Exeter seam alone, which is the most reliable one in this county, will furnish an ample supply for all local demands. From its position at the very base of the measures, it must necessarily underlie the whole extent of surface which the Coal Measures cover, and no natural exposure of the proper horizon for this coal was seen, but the coal itself was present. The seam varies in thickness from two to three feet, and has a good slate roof that admits of the removal of all the coal, and requires only a moderate expense for cribbing; and the coal it affords is better than an average of the Illinois coals in quality. In the summer of 1853, while engaged in making a preliminary examination of the counties adjacent to the Illinois river, I found that "Frost's coal" had a wide-spread reputation throughout the adjoining counties on both sides of the river as the best smith's coal in this portion of the State; and I fully expected, on reaching the locality of this coal, to find that it was furnished by a different seam from any that was worked in the adjacent region. But, on reaching Frost's mine, I was somewhat surprised to fine that his celebrated smith's coal was obtained from the same seam that I had been tracing through the adjoining counties, and that its enviable reputation was solely due to the judicious manner in which the mine was worked. The top coal, which was quite free from sulphuret of iron, was separated from the inferior portion in mining; and the different qualities of coal were sold at different prices and for the special uses to which they were best adapted. If the coal miners and dealers generally in this State would adopt a similar system, it would tend to greatly improve the reputation

of the Illinois coals wherever they are used. Three analyses were made by Mr. PRATTEN, of coal from this seam in Scott county, with the following result:

BARKER'S COAL.

Specific gravity	1.2396
Loss in coking	42.8
Total weight of coke	57.2—100.00
Moisture	5.5
Volatile matters	37.3
Carbon in coke	52.2
Ashes (light brown)	5.0—100.00

EXETER MINE.

Specific gravity	1.288
Loss in coking	42.37
Total weight of coke	57.63—100.00
Moisture	12.10
Volatile matters	30.27
Carbon in coke	50.13
Ashes (red)	7.50—100.00

FROST'S COAL.

Specific gravity	1.2883
Loss in coking	46.37
Total weight of coke	53.63—100.00
Moisture	8.50
Volatile matters	37.87
Carbon in coke	46.53
Ashes (red)	7.10—100.00

It is but just to add that these analyses were made from selected specimens of these coals, and may be taken as fairly representing that part of the seam affording the smith's coal. Barker's mine is two miles and a half northeast of Winchester, on the southeast quarter of section 22, township 14, range 12. The coal at this locality averages about thirty inches in thickness, and has a good slate roof. This seam of coal will yield about two and a half million tons to the square mile, and probably underlies as much as three townships, or one hundred and eight square miles in this county.

Clays.—The most extensive and valuable deposit of clays to be found in this portion of the State is that underlying the Exeter coal seam. In the vicinity of Winchester it is from ten to twelve feet in thickness, and is most readily procured from those localities where the overlying strata have been removed by erosion, and the clay has been subjected to atmospheric influences during the Drift period, which have had a favorable effect in rendering it fit for immediate use. The same effect may also be produced by throwing it out of the bed, and exposing it for several months to atmospheric influences. It sometimes appears as a regularly stratified clay shale,

and again as an unstratified fire-clay. Its color is a light ashy-gray, inclining to yellow. It outcrops along the western borders of the coal field, sometimes lying immediately under the Exeter coal, and at other localities separated from the coal by the steel-gray nodular limestone already noticed. It varies in thickness from three to twelve feet, and was found at every locality in this county where the base of the Coal Measures was exposed; and its near proximity to the coal adds materially to its value. It will afford an inexhaustible supply of material suitable for the manufacture of drain-tile, potter's ware, and fire-brick. The brown sub-soil clay upon the uplands everywhere furnish material suitable for the manufacture of common brick; and the sand necessary for the same purpose, and for mortar, is abundantly supplied from the beds of modified drift in the valleys.

Iron Ore.—Bands of hematite iron ore were found at two localities in this county, one of which was at Moore's coal mine, on Little Sandy. At this point, there are two bands of nodular ore, from six inches to a foot in thickness, in the shales between the potter's clay and the lower Carboniferous limestones. At about the same horizons there is a similar band in the vicinity of Exeter, which is about a foot in thickness. These hold the same stratigraphical position as the iron bands noticed on Whitaker's creek, in Greene county. They are probably too thin at these localities to be profitably mined at the present time.

Hydraulic Limestone.—At several localities in this county, the St. Louis limestone affords beds of earthy buff-colored or yellowish-gray limestone, that presents all the usual characteristics of a hydraulic rock, some of which will no doubt become valuable for the manufacture of cement. We have been unable to obtain an analysis of these limestones in time to be incorporated in this report; and it will perhaps be sufficient for the present to direct the attention of those owning the quarries to the fact of their occurrence here, that they may test by actual experiment their fitness for hydraulic purposes. At the quarries about a mile southwest of Winchester, and at the hill on the Naples road, a half mile west of Exeter, beds of this kind were observed; and they may no doubt be found at other localities in the county.

Limestone for Lime.—The Burlington limestone, which forms the river bluff in the southwest part of the county, will furnish an ample supply of material for this purpose, which, if not equal to that made from the St. Louis limestone, will afford a very good

lime for mortar and for all ordinary uses. In the vicinity of Winchester, the evenly-bedded bluish-gray limestone of the St. Louis series will afford a superior article of lime, and an abundant supply for all the eastern portion of the county. The same beds in the vicinity of Exeter are equally well adapted for this purpose.

Building Stone.—This county is generally well supplied with good building stone, especially in the middle and western portions. From Glasgow south and west to the river bluffs and the Greene county line, the Burlington limestone outcrops on all the streams, forming limestone bluffs from fifty to a hundred feet in hight. The rock is a massive light-gray or brown crinoidal limestone, and often affords strata two feet or more in thickness, which dress easily and form an excellent and durable building stone. Owning to the expense of transportation, until additional facilities are obtained, its use will necessarily be restricted to the southwestern part of the county. The St. Louis limestone also affords good building stone, especially for foundation walls and heavy masonry, such as abutments and culverts, to which the brown magnesian beds of this formation are well adapted. Along the river bluffs above the *Mauvaisterre*, the arenaceous beds of this formation are generally used, and make a good building stone. The middle and eastern portions of this county, within the area of the coal field, may be supplied to some extent from the sandstone overlying the Exeter coal seam, which, at many localities, will be found to afford a durable stone. But in all cases a Coal Measure sandstone should be selected with much care, where it is used as a building stone, and always rejected if it does not stand exposure well at the natural outcrop of the bed.

In natural resources, and all the material elements of wealth, it will be seen, from what has already been said, that Scott county ranks among the most favored in this portion of the State. With a soil of unsurpassed fertility, an abundant supply of excellent timber, with bituminous coal of good quality, and building stone, potter's clay, etc., in abundance, it would be difficult to find a locality where greater inducements are offered to the industrious and enterprising immigrant, who is seeking a home within the borders of our highly favored State, than are to be found in this county.

This county now possesses ample railroad facilities for transportation. The C. B. & Q. railroad intersects it from north to south, the Jacksonville, Alton and St. Louis railroad crosses the southeast corner of the county, and the Naples branch of the Great Western road the northwest corner. The Illinois river, which forms its

western boundary, affords a cheap outlet, by water transportation, for all the agricultural products of the county. The wide belts of bottom lands, adjacent to the Illinois river, possess a very fertile soil, and produce annually large crops of corn and other cereals, and, where sufficiently elevated to be above the level of the annual overflows, will perhaps yield a more liberal return for the labor expended in their cultivation than any other lands in the county.

CHAPTER V.

WASHINGTON COUNTY.

BY HENRY ENGELMANN.

Washington county is bounded on the west by St. Clair county, on the north by Clinton county, on the east by Jefferson county, and on the south by Randolph and Perry counties. It embraces, in the main, townships 1, 2, and 3, south of the base line, in ranges 1, 2, 3, 4 and 5 west of the third principal meridian; but only its west, south and east lines are straight. The northern boundary line, which separates it from Clinton county, follows the Okaw or Kaskaskia river, to the mouth of Crooked creek; then, the latter to near the mouth of Grand-point branch; then, a section line two miles north of the base line, through township 1 north, range 1 west, to the third principal meridian. The county thus embraces an area of a little over fifteen townships, or about five hundred and fifty-seven square miles. A little more than one-half of this, or about fifty-two per cent., is prairie.

The counties west and south of Washington county—St. Clair and Perry—are considered amongst the richest in the State for their inexhaustible wealth of stone-coal. The coal-bearing strata of these counties dip to the east and northward, underneath those of Washington county; and we may, therefore, very properly conclude that the coal seams of those counties extend also into this county, only at greater depth. Hence, the geological formation of this county is the upper Coal Measures, embracing strata that range higher in the geological series than any discovered in St. Clair and Perry counties.

Surface Configuration.—The surface of the county is considerably diversified, and is watered by numerous streams. In the northern and western parts, the water-courses run into the Kaskaskia river, and are designated as follows: Grand-point creek, Crooked creek,

Little Crooked creek, Plum creek, Elkhorn creek; and in the southwest, Mud creek. The southeastern part of the county is drained toward the Big Muddy river by Locust branch, Beaucoup creek, and Little Muddy river. The whole width of the county is only eighteen miles; and the ascent from the Kaskaskia river to the dividing ridge, which passes a little beyond the middle of the county, is therefore considerable, and produces the principal inequalities of surface configuration observed in the county. The whole southeastern half of the county is high land, embracing the dividing ridge between the different systems of drainage; and spurs of that ridge extend northward and southward between the principal tributaries of the larger streams.

The prairies occupy all the flat or rolling land at some distance from the main streams, while the low bottom lands along the water courses, and some of the high lands next adjoining them, are covered with forest, as well as the more broken portions of the ridges near the upper courses of the streams, where these have cut their channels deep into the hills. The prairies are therefore of two classes—those that are a little elevated and rather level near the lower course of the streams, and more elevated and rolling prairies on the higher ridges. The latter are the so-called "ridge prairies," while the former are sometimes designated as "bottom prairies."

Beginning in the southwest corner of the county, we have first an arm of Grand Coti prairie—a regular ridge-prairie between the tributaries of Kaskaskia and Beaucoup rivers. Then comes Mud prairie, a rather low and flat prairie between Mud creek and its tributary, Little Mud creek. Next follows Elkhorn prairie. Its northwestern end, near Kaskaskia river and the lower course of Elkhorn creek, is several miles wide, rather flat, and not much elevated; but it increases in elevation toward the southeast, and continues as a narrow ridge-prairie, with steep breaks at its margin, round the head of Elkhorn creek, and between it and the branches of Mud creek and Swanwick creek. Then its name is changed into Nashville prairie or Grand prairie. Grand prairie is a wide, flat and moderately elevated upland prairie, in the neighborhood of the Kaskaskia river, between the lower Elkhorn creek and Little Crooked creek; but it rises toward the south, and forms a high prairie ridge, which is most conspicuous from near the head of Plum creek, toward Nashville. This prairie ridge continues eastward toward Richview, forming the summit of the divide between the various tributaries of the Kaskaskia and Big Muddy rivers. It also sends off branches west and east of Grand-point creek, and southeastward beyond Ash-

ley. These are all known as Grand prairie, and become lower and flatter toward the lower course of the creeks, especially toward Crooked creek. Beside these main prairies, we find some smaller ones between the branches of Elkhorn creek—one on the ridge between the Beaucoup and Locust branch; then Three-mile prairie, somewhat lower down on the west side of Locust branch; and finally, in the extreme southeast part of the county, another, called Mud prairie—a flat ridge-prairie between Beaucoup and Little Muddy rivers.

The timbered portion of Washington county, especially in the southern part, where the timber prevails largely over the prairie, closely resembles in every respect the adjoining districts of Perry county. We have here the same postoak flats wherever the ridges are sufficiently level; the oak and grass barrens, where they are more rolling and broken; and the older forests, where the land is most broken. Thus we find postoak flats on the north side of Mud creek, southeast of Mud prairie; then east of Elkhorn creek, near the Little prairie; between Locust branch and Watering branch; between Locust branch and the Beaucoup; east of the latter, toward Dry prairie and Mud prairie; and east of the Little Muddy. In the northern part of the county the extent of timber is much more limited, and is chiefly confined to the bottom lands of the streams, and to narrow belts of land between them and the prairies.

In conformity with the predominating prairie character of the county, and on account of the softness of most of the strata, outcrops of rocks are quite scarce, and rocky cliffs are only developed on a small scale; and on several of the creeks hardly a single outcrop of rocks has been discovered. At a few points a considerable thickness of rock is exposed, although seldom in a continuous outcrop. On the upper course of Mud creek, and on its branches, I observed considerable outcrops of rocks, while in its lower course, even in this county, it is confined between banks of clay. Of Elkhorn creek we can say the same. In its upper course it has worn its channel through the same strata as Mud creek, and winds its tortuous way past many a bold cliff of rock. On Little Mud creek, on the contrary, we find only a single small exposure. On Kaskaskia river, as far as it forms the boundary of this county, and for a considerable distance above and below, only a single small outcrop of rocks is known, and but two, close together, on Crooked creek. Little Crooked creek and Grand-point creek have each a few hardly perceptible outcrops far apart along their banks, On the branches of Swanwick creek, and on Locust branch, we do not find a single

one; but there are some on Watering branch, and on the upper course of the Beaucoup, and the same ledges make their appearance also at several points on Little Muddy river.

Geological Formations.

The upper part of the Coal Measure formation prevails all over Washington county, to the exclusion of all other strata except the Quarternary deposits covering the surface. It contains only some thin seams of coal, and overlies the lower Coal Measures, the coal-bearing formation of Perry and St. Clair counties. This latter formation undoubtedly extends underneath the strata of Washington county, and thus far we have no reasons whatever for doubting that the coal-beds which are found in the adjoining counties, may also extend under Washington county, only at a greater depth, and that they may be opened and worked whenever a sufficient demand for coal has been created to warrant the necessary outlay of capital.

SECTION OF THE COAL MEASURE STRATA.

[IN DESCENDING ORDER.]

1. *The Upper Sandstone Formation.*—It consists principally of sandstones and arenaceous and argillaceous shales, with calcareous intercalations. These latter do not form heavy ledges, but either thin layers of rather pure or slaty limestone, or else heavier layers of very much mixed rock, of calcareous sandstone or mudstone. Such is the rock at Joliff's mill, on Crooked creek, which is supposed to be about sixty-two feet above the base of this division, but is perhaps a higher stratum. Another calcareous ledge is found in the upper part of this formation in Washington county, together with a seam of stone-coal from eight to twelve inches in thickness. Some coal has also been observed irregularly distributed through a sandstone, sixty or seventy feet above the base of this division. The aggregate thickness of this upper sandstone formation in Washington county is estimated at between two hundred and two hundred and fifty feet.*

*We are at a loss to know on what evidence the above estimate is based, for in the section of the Nashville shaft, given on a following page, which is sunk at one of the most elevated points in the county, and through superficial deposits only eleven feet in thickness, we find that but sixty-nine feet of strata, including sandy and argillaceous shales, sandstone and impure limestone, were passed through above the Shoal creek limestone; and at Richview, a limestone supposed to be the Shoal creek bed, was passed through in

2. *The Shoal Creek Limestone.*—A light-colored, grayish or bluish compact, close-textured limestone, averaging seven feet in thickness, which is remarkable for its uniform development over a wide range, far beyond the limits of this county, whereby it affords a marked division line in the series of formations.

3. *The Slaty Division.*—Below the Shoal creek limestone generally follow some two or three feet of black laminated slate, which at some points contains a thin streak of coal; then shales, arenaceous shales or sandstone; and finally more slates, generally with a thin layer of slaty limestone or merely with calcareous concretions, and a stratum of coal from eight to sixteen inches in thickness. This slaty division varies in thickness from fifteen to fifty feet.

4. *The Lower Sandstone Formation.*—It consists mainly of sandstones and arenaceous and argillaceous shales, and corresponds to the sandstone formation of the upper part of the Coal Measures of St. Clair and Perry counties. Its aggregate thickness amounts to two hundred and seventy feet. Its lower portion is prevailingly shaly, while in its upper half, at Nashville, seventy feet below its upper end, it contains a calcareous stratum which generally has the appearance of a pudding-stone, composed of limestone and sandstone, but at other points forms a ledge of rather pure limestone, underneath which we find more or less stone-coal, usually forming a seam of from six to twelve inches in thickness. At many points the lime is thoroughly mixed with the sand, so that we only find hard calcareous sandstones. There are probably other local intercalations of calcareous matter in this formation.

The lowest strata of the series which actually crop out in Washington county, are found in its western and southwestern parts. On Little Mud creek, a quarter of a mile east of the St. Clair county line, in the northwest quarter of section 19, and a little higher up the creek, near the south line of section 18, township 2, range 5, some irregularly and thinly stratified and rather solid sandstone is barely exposed to view in the bed of the creek, and these are the only outcrops along it. The same layer has been struck in Mud prairie, a mile and a-half farther south, near Mr. C. Benner's, in the northwest quarter of the southwest quarter of section 30, at

---

the shaft at that point, at a depth of one hundred and twenty feet; but, as the thickness of the superficial clays in this shaft is not stated, we cannot know exactly the thickness of these upper shales at that point. They are probably, however, not over one hundred feet thick, and this would no doubt be a much nearer approximation to the aggregate thickness of the strata above the Shoal creek limestone in this county than that given above.

A. H. W.

a depth of thirty feet. Still farther south, in the northwest quarter of section 31, it appears that some slaty shales, with kidney iron ore, were found in a well above the sandstone. Such shales, partly slaty, partly arenaceous, have been struck at numerous points farther east in this prairie, in the east part of section 29 and in the northeast quarter of section 32, in section 33, and in the adjoining township 3, range 5, in the east part of section 4, in the west par of section 3, and on much higher ground in the northeast quarter of section 3. Generally, they have not been penetrated more than a few feet, and they seem to present an uneven surface, because at other points, sometimes only a few yards distant, water has been found in quicksand and no rock discovered.

At the south side of Mud prairie, sandstone, corresponding apparently to that mentioned above, has also been struck in a well in the northeast quarter of section 18, township 3, range 5, at a depth of twenty feet; but on Mud creek itself, no rocks are exposed in the west part of this township; and the first outcrop which I noticed in its banks consists of the argillaceous shales, with kidney ore and other concretions, in the northwest quarter of section 22. On the higher ground, in the barrens south of Mud creek, west and east of the arm of Grand Coti prairie, in the south part of township 3, range 5, in which no rock is struck in the wells, sandstones are exposed at various points, and might be found any where at a little depth by digging. They have been quarried close to the St. Clair county line, in the southwest corner of section 19, where they are of a light greenish-yellow color, and closely resemble those quarried some miles east of Athens, in St. Clair county, of which they undoubtedly form the continuation. They were also noticed in a ravine in the northeast corner of section 31, where it has been ascertained by boring that they overlie dark-colored shales with kidney ore; and I saw them exposed in the south part of section 22, and in sections 26, 35 and 36, where they are generally of a light-brownish color. In the barrens north of Mud creek, in the northeast part of township 3, range 5, exposures of rock are more scarce, but I noticed the sandstones on a branch in the southeast quarter of sertion 11, and at a few other points. The first outcrop of these strata on the main creek was observed in the south part of section 23, where it forms an overhanging cliff at the water's edge, more than twelve feet high. Thence, up the creek, we meet with an occasional rocky cliff.

In the adjoining township, 3, range 4, this formation is more exposed. The sandstone has been struck in several wells in the

southwest part of the Elkhorn prairie, on the side toward Mud creek. In the northwest corner of section 21, township 3, range 4, a well, eighty feet deep, passes mainly, if not exclusively, through sandstone, from twenty feet below the surface downward. In its lower part, a few scattered and irregular thin streaks of coal were observed in the rock. Another well on the east side of the southeast quarter of section 20 is likewise eighty feet deep, and penetrates the same strata. Another one, on a low prairie hill, near the middle of the west line of section 22, showed some shale fifteen feet below the surface, and then sandstones to a depth of ninety feet; while in other wells in the same section and vicinity, water is obtained at no great depth, and before any rock is struck. A branch of Mud creek which heads in this vicinity, in the west part of section 28, and runs through section 29, presents nearly continuous outcrops of sandstone from its head for a considerable distance downward. The rock is mostly rather soft, and in its upper part I noticed only a single thin intercalation of shales. At the foot of the breaks, whence the branch has much less fall, the rock was strongly cemented, somewhat calcareous, and even splintery in fracture, and there were some streaks of black carbonaceous slate, which may contain a little coal. I also noticed some large tumbling slabs of limestone of the Coal Measure formation, which evidently forms an intercalation in the sandstones, being, perhaps, substituted at some points for the calcareous layer of sand-rock. Continuing along the branch, in the south part of section 29, I observed a considerable layer of a calcareous pudding-stone, consisting of concretionary masses of limestone, disseminated more or less in a sandy matrix, a combination of sand and lime in one stratum. This rock also occurs on Swanwick creek, in the northwest part of Perry county, and also in the shaft at Summerfield, in St. Clair county, in this same division of the Coal Measures. Underneath it, followed some argillaceous slate, and then a few inches of slaty coal.

At the Mud creek bridge, on the Sparta road, a mile further south, in the south part of section 32, we find, at the foot of the hill, a considerable thickness of gray argillaceous and arenaceous shales, with concretions of carbonate of iron; above them a black streak, apparently the rotten outcrop of a carbonaceous shale or slate, and then some large slabs of limestone; the whole undoubtedly corresponding to the exposure described above. A short distance down the creek, near the middle of the west half of section 32, I observed a heavy ledge of sandstone about twenty-five feet above the water. It was underlaid with a thin layer of the calcareous pud-

ding-stone, then thin streaks of carbonaceous matter, and finally shales which reached to the water. For some little distance along the creek we observed similar outcrops, with a varying thickness of the single layers. Another bluff of this formation, on the south side of the creek, in the northeast corner of section 31, shows eighteen inches of arenaceous material, irregularly penetrated by streaks of coal in oblique and curved lines, intercalated between beds of solid sandstone. Close by, there appeared two or three inches of coal, covered with a little slate, seemingly lower down than the lowest of these two beds of sandstone, and, only a few yards distant, arenaceous shales from the bank of the creek, occupying the place of the lower sandstone.

From the foregoing remarks, we see that this part of the formation is quite variable in its details, because the above sections evidently present repetitions of the same strata. It consists, where regularly developed, of some shales, a little stone-coal and slate, and a thin bed of limestone intercalated between sandstones. Locally, however, sand appears to have been deposited contemporaneously with the limestone, when, instead of a pure limestone, the pudding-stone or concretionary arenaceous limestone was produced, or even a hard calcareous sand-rock. At other points, the irregularity was even greater. There is no doubt in my mind that this is the continuation of the limestone and thin seam of coal which occur on the north side of Grand Coti prairie, in Perry county, of the pudding-stone on Swanwick creek, and perhaps even of the streaks of coal in the sandstone on the upper Beaucoup, in Perry county; also of similar formations in the Summerfield shaft, in St. Clair county.

The higher sandstones which form the ridge towards Elkhorn prairie continue northeastward along the prairie. They are considerably exposed near the head of a branch of Mud creek, a short distance southwest of Elkton, in the northwest quarter of section 8, and the southeast quarter of section 7 (?) township 3, range 4. In the prairie at Elkton, they have been struck in wells at a depth of twenty feet, and penetrated forty feet without showing any intercalations of other rocks. At other points, they reach even nearer to the surface. At higher points, shales are said to be found next to the surface, as in the east part of section 9, and in section 16, and in a well a mile west of Elkton, in the southeast quarter of section 6. Farther west, in a well, also on high ground, on the south side of the prairie near the center of section 1, township 3, range 5, the sandstones were again struck at a depth of twenty-two feet. Thence northwestward, no rocks have been found through the whole extent

of Elkhorn prairie, except at some points on its northeastern margin, toward Elkhorn creek.

At Venede, which is situated at the edge of the lower part of the prairie, near Elkhorn creek, in the northwest quarter of the southwest quarter of section 34, township 1, range 5, a well dug on low ground passes through fifty feet of Quaternary deposits, and twenty feet of shales, the lower portion of which was quite hard. Several wells in the west part of section 33, also on low ground, are said to have penetrated a layer of limestone from eight to twenty feet below the surface. The stratum referred to is undoubtedly far above the Belleville coal, and may be a local intercalation in the lower part of this sandstone formation. Perhaps it corresponds to the limestone described above on Mud creek; or it may even be another hard rock mistaken for limestone. On Elkhorn creek, for some miles above and below Venede, we find no rocky out-crops whatever, only a few high banks of Quaternary clay, sand, gravel, etc., while the bed of the creek is generally muddy.

Three miles southeast of Venede, in the southwest quarter of section 11, township 2, range 5, shales were once more struck in a well, and in the northwest quarter of the northeast quarter of section 14, soft shaly sandstones were found. In the slope at the edge of the creek bottom, on the line between sections 11 and 14, highly arenaceous shales are laid bare in the road. This appears to be the first outcrop of the arenaceous portion of formation 4, which extends thence to the head of Elkhorn creek, forming the continuation of the strata described on Mud creek. In the southeast part of section 14, slaty shales were struck in the wells in the edge of the timber; and at the edge of the prairie, a little east of St. Peter's church, or Stone church, which is situated on the northwest quarter of section 23, they were again found ten feet below the surface, and penetrated several feet. Further southeast, Mr. Borchelt dug a well on the northeast quarter of section 23, at the edge of the timber, considerably below the summit of the prairie. He also passed through the shales, and struck a ledge of hard sand-rock at twenty-two feet, and underneath it a thin seam of coal. On the small branch in the south part of the adjoining section (24), I observed various outcrops of the arenaceous shales, and blue slaty shales, and, higher up the branch, in the north part of section 25, sandstones, which evidently alternate with the shales. The sandstone has been considerably quarried in this vicinity. It resembles that in the southwest corner of the county, and is mostly light-colored, yellowish, greenish, or brownish, rather soft, of a rather fine grain,

dresses well, and breaks in slabs of suitable thickness. At the head of a ravine, in the northwest quarter of section 25, at a higher level than the quarry, I noticed hard, thinly and irregularly stratified sandstones, underlaid with some feet of shaly sandstones, and then a little slate and some stone-coal, which would seem not to exceed a few inches in thickness. A boring made lower down the branch was carried about eighty feet deep, passing mostly through shales. In the northeast corner of section 26, Mr. Meier also found arenaceous shaly strata in his well.

East of this point, on Elkhorn creek, the sandstones are extensively exposed, and the first outcrop above its mouth was found in the northwest quarter of section 19, township 2, range 4. The next one, similar to the first, is nearly opposite the mouth of Williams' fork, in the southeast part of section 19. Then, in the northwest quarter of section 29, some hard and thinly stratified sandstone crops out at the water's edge. In the southwest part of section 29 (?), the sandstone forms a bluff bank nearly twenty feet high, and is mostly soft and massive in structure, with some harder ferruginous portions; generally, however, the banks of the creek consist of Quaternary clays, forming at some points high banks, strewn with drift pebbles and some rolled fragments of a hard Coal Measure limestone. The sandstone continues up the creek, and crops out at intervals in the southeast quarter of section 33, township 2, range 4, and in the east part of section 4, township 3, range 4. It forms the whole ridge toward Elkton, in the breaks of which it is exposed to a considerable thickness, without any intercalation of other strata. Through section 10 it forms numerous cliffs along the creek, some of which are twenty feet high. At the forks of Elkhorn creek, in section 11, higher strata appear to replace it. The rocks there are micaceous and arenaceous shales, with single harder layers of sandstone between them. They crop out occasionally to the middle of the west half of section 14, where I observed above them a layer of hard, firmly-cemented, calcareous sandstone, which is splintery in fracture, about sixteen inches thick, splits evenly, and contains numerous traces of coal plants. It is generally called bastard limestone in this vicinity, and is extensively quarried. Above it, I find some inches of soft blue slate, which has frequently been mistaken for a rotten coal, and then more sandstones of a rather massive texture, which continue to the head of the breaks in the northwest quarter of section 23, and in the southeast quarter of section 15. On the other branch of the creek, in sections 11 and 12, I also

observed the shaly strata, and on the east side of section 12, at the edge of the prairie, much hard, thinly-stratified sand-rock. I am informed that the blue calcareous rock and the black slate have also been found in the breaks of this branch.

East of the main creek, in the midst of a little elevated post-oak flat, is the Little prairie. At its south side, in the northeast quarter of section 34, township 2, range 4, a well has been dug twenty-eight feet, through Quaternary deposits, and then twenty-four feet into alternations of sandstones and arenaceous shales, the last six feet being solid sandstones. In the banks of Williams creek, a fork of Elkhorn creek, northeast of that prairie, the sandstones crop out in the south part of section 22, and in the middle of section 26. In the northwest quarter of section 26, much tumbling, rounded limestone is strewn in the bank, the same which had been observed, together with the drift-boulders, on Elkhorn creek; but no further outcrops were found on the creek, neither lower down nor higher up, except, perhaps, toward its head, near Grand Prairie. On the northern fork of Williams creek, not a single outcrop occurs; but, close to it, near the middle of the south half of section 14, the sandstone is in place at the bottom of a well.

Farther northwest, in the southeast quarter of section 10, township 2, range 4, in the timber, at the edge of Grand Prairie, hard rock is in place at the bottom of a well, twenty-two feet below the surface. From the account which I received, it seems to be hard sandstone. A mile and three-quarters farther west, in the southeast corner of section 8, also at the southern edge of Grand Prairie, some hard, strongly-cemented sandstone forms the bottom of a well; and, two miles north from there, at the edge of the timber near a branch of Elkhorn creek, in the southeast quarter of section 32, township 1, range 4, and a quarter farther south, in section 5, township 2, such sandstones have been struck and penetrated a few feet in shallow wells. Again, three miles farther northwest, in the post-oak flats, between the prairie and Okaw river, in the northwest quarter of section 24, township 1, range 5, the sandstone was struck at a depth of twenty-two feet. These are the only traces of the sandstone formation which was so prominently developed and exposed on the upper course of Elkhorn and Mud creeks. They are, however, sufficient to prove that this western arm of Grand Prairie is underlaid with this sandstone formation, underneath the covering of Quaternary deposits, in which the water is generally obtained, and below which the wells do not penetrate.

Near Plum creek this sandstone formation crops out, and has been quarried on a branch close to the creek, south of the center of section 21, township 1, range 4. It is little exposed, and is partly shaly, partly firm; some of it is ripple-marked. At Bridgeport, which is situated in the northwest corner of section 21, it has been struck at a depth of twenty-one feet, in digging near the creek; but on higher ground shales were found at a depth of about twenty feet, over twelve feet thick. These undoubtedly form an intercalation in the sandstone formation. On some hills east of the creek, in the center and on the northeast quarter of section 22, shaly sandstones have been found in several wells. East from there, no rocks have been discovered for several miles; but the next outcrops which we find in that direction are formed by a higher formation.

At the Stone coal ford of the Okaw, in the southeast quarter of section 1, township 1, range 4, is the only outcrop of rock on that river, so far as it forms the boundary of Washington county. The lower part of the bank and the bed of the river consist of gray and greenish argillaceous shales. Next higher follows a seam of coal, capped with black slates, which are only exposed when the water is not very high; and then, high banks of Quaternary clay, etc., which form abrupt but not very high hills. The coal and slate are together about eighteen inches thick; the coal, from ten to twelve inches. Besides drift gravel, I noticed tumbling pieces of brown, highly-fossiliferous limestone, which closely resembles No. 9 of the Nashville section; and, especially a short distance above the ford, numerous large masses of limestone closely resembling the Shoal Creek limestone. The latter were so numerous that I was forced to the conclusion that this rock must underlie the upper part of the adjoining hills, and that the foot of the hills at the ford was formed of the underlying slates and shales. This conclusion was still further substantiated by finding large blocks of the Shoal Creek limestone near the head of the little branch which empties just above the ford, near the middle of the east line of section 12, and lower down on the branch. About two and a half miles farther east, toward Little Crooked creek, it was found in place.

Southward, the prairie rises considerably, and forms a prominent ridge of hills, which extend from the head of Plum creek, toward Nashville and the main dividing ridge. The first of these hills is Plum hill, in the middle of section 3, township 2, range 4. In a well there, black slates were struck, and a little limestone, undoubtedly the lower part of No. 3 of the county section. By digging a few feet deeper, probably the same thin seam of coal would have

been found which crops out at the Stone Coal Ford, on the Okaw river. In other wells near by, shales were struck, probably those underneath the black slate and coal. While the wells here do not generally reach down to the rocks, slaty shales were struck at the south side of the prairie, in the northwest quarter of section 14, and in the prairie in the northwest quarter of section 12; the latter belonging apparently between the black slates and the Shoal Creek limestone, which is found in wells soon after crossing the range line, in section 7, township 2, range 3.

Farther southeast, I could not distinguish the minor subdivisions below the Shoal Creek limestone, and finally, owing to imperfect exposure of the strata, I lost even the division line between them and the main sandstone formation, or Nos. 3 and 4 of the county section. Shales overlying the lower sandstones, besides at the above mentioned points, were struck in wells on the east side of a small prairie, near the east line of section 24, township 2, range 4, and on the slope near the head of Williams creek, in the northwest quarter of section 30, township 2, range 3. In the creek at this point, so large a quantity of limestone is strewn that one might be disposed to conclude that there was a layer of limestone in place near by; but the rock is associated with drift boulders, and most probably originates from the Shoal Creek limestone, on the higher ridge. The above mentioned shales were also found in wells farther south in the prairie; at the meeting-house near the west line of section 31; also in the northeast quarter of section 31, township 2, range 3, and, I believe, in section 6, township 3, range 3. In a well near the northwest corner of section 33, rock has also been struck at a depth of twenty-five feet, and has been penetrated several feet. A little south of east from there is a high prairie hill, near the head of Locust branch, hardly lower than the main dividing ridge. On this hill, in the west part of section 34, township 2, range 3, Mr. Eads dug a well one hundred feet deep, and, getting no water, he bored nearly as much deeper after coal. I could not obtain a satisfactory account of this work. I only ascertained that the Shoal Creek limestone did not reach that far, but that the formations passed in the well are all lower than that limestone, consisting mostly of shales and sandstones. It is doubtful whether the black slates and coal No. 3, of the general section, were found. A thin streak of coal was drilled through, at a depth of at least one hundred and fifty feet, corresponding apparently to No. 14 of the Nashville section, in the lower sandstone. Farther south in the prairie, part of the wells strike rocks: One near the middle of the east

line of section 5, township 3, range 3, struck sandstone at twenty-three feet, and penetrated it ten feet. Another one, just a mile farther south, penetrated it fifteen feet. Another one, in section 17, twenty-eight feet deep, struck shales. In the northeast quarter of section 19, and the northwest quarter of section 20, shales and a hard rock, probably a somewhat calcareous sandstone, were reached. All these strata are lower than the Shoal Creek rock, and include, perhaps, the upper part of the lower sandstone. Similar strata have been discovered in wells near the southern edge of the prairie, in the southeast quarter of section 27, township 3, range 4; in the southeast quarter of section 24 of the same township; and at the Pilot Knob, in the northeast quarter of section 30 (?), township 3, range 3. At the eastern edge of the prairie, a well was dug near the center of section 27, township 3, range 3, sixteen feet through surface deposits, and then forty-five feet in solid sandstone. Another, not far from the center of section 22, is seventy-five feet deep, mostly in sandstone, with some shales above it; and a great thickness of sandstones was also found in a well farther north, near the center of section 15.

In the barrens west of Locust branch, this sandstone formation continues cropping out in section 23, and on a small branch north of Three-mile prairie, in the east part of section 26, and in section 25, township 3, range 3. In Three-mile prairie, the sandstone is exposed on a ravine in the middle of the west half of section 36. At the west side of the prairie, in the west part of section 35, a well has been dug seventy feet deep, nearly altogether through solid sandstone. At a depth of forty feet, some irregular streaks of coal were found in the rock, but no well-defined vein. This, together with the blue, hard, calcareous sandstone which is exposed on a branch in the east part of section 1, township 4, range 3, a short distance south of the county line, reminds me strongly of a similar formation near the south end of Elk prairie, and on Mud creek, of which this forms apparently the continuation. The sandstone is also exposed, at the south side of the prairie, on ravines in the southwest quarter of section 36, township 3, range 3, and near the southwest corner of section 31, township 3, range 2.

On Locust branch, strange to say, the sandstones do not outcrop, nor in the hills between it and the Beaucoup, although they are undoubtedly underlaid with this formation. At the head of Locust branch I noticed loose fragments of sandstone, but they originate from higher layers. In the northwest quarter of section 2 (?), township 3, range 3, I observed in the bank pieces of a brown, highly

fossiliferous limestone, apparently from the same layer which has been struck at Nashville, in connection with the black slate No. 3 of the county section. It would, therefore, seem as if this stratum passed through the hills above this point. In the southwest quarter of section 13, and in the north part of section 24, some distance above the mouth of Watering branch, we find much loose sandstone in the banks, together with drift boulders; and thence down to the county line, high clay banks, with boulders, are to be seen, now and then, but no strata in place. On the branch, the sandstone crops out at several points of its lower course, and on some of the ravines, in the adjoining barrens, especially in the southwest quarter of section 8, and in section 18, township 3, range 2. Three-quarters of a mile above its mouth, in the northwest quarter of section 19 (?), a streak of coal, from one to two inches thick, is said to have been noticed in the rock. Higher up the branch, in the southwest quarter of section 5 (?), a man once dug eight feet down in the bank of the creek, and is reported to have found six inches of coal. I noticed fragments of shale and slate which he had thrown out. As large masses of the Shoal Creek limestone are found near by, I have little doubt but that this was the small seam of coal which is generally found a short distance below this limestone formation—No. 11, of the Nashville shaft. A little lower down, in the northwest corner of section 8 (?), shales, with concretions of carbonate of iron, were dug up close to the creek, evidently from nearly the same geological horizon.

On Beaucoup creek, the strata below the Shoal Creek limestone first reach the surface in the northeast quarter of section 27, township 2, range 2, and from there extend southward along the creek for about two miles, while the limestones still continue in the hills. At that point, in section 27, twelve feet of shaly sandstones are exposed at the water's edge, and the limestone is in place only a few feet higher up. The shaly strata are then found at numerous points down the creek, in the south part of section 26, and the north part of section 35. In the east bank of the creek, in the southwest quarter of section 35, I observed, above some gray shales, a seam of coal eight inches thick, capped with some slate, and, close by, more of the arenaceous shales were exposed. The coal crops out with the same thickness, a short distance farther east, on a branch of the Beaucoup, on the south line of the same quarter of section 35; and Mr. Patterson, in boring fifty feet deep, at a quarry of the Shoal Creek limestone, in the hills far southwest, in the northeast quarter of section 3, township 3, range 3, passed through black

slate and shales, underneath the limestone, and, at a depth of twenty-five feet, struck three feet of black slate, with some inches of coal. The coal, at all these points, is unmistakably No. 11 of the Nashville section.

Lower down on the Beaucoup, gray shales, with thin intercalations of sandstone and concretions of iron ore, and some black slates, were found exposed in the southwest quarter of section 2, or the southeast quarter of section 3, township 3, range 2; then, near the middle of the north half of section 10, a bluff of sandstone, thirty feet high, is seen, where the rock is partly shaly, partly firm enough to be quarried for building stone. Shaly arenaceous strata crop out in the bank of the creek for some distance above, and also below the mouth of Sugar creek, in section 15; but the next outcrop on the creek occurs several miles farther south, close to the county line, and also consists of sandstones. Panther creek also exhibits no rocks on its lower course; but, far up in the barrens, I observed some shales in the east part of section 24, and the sandstones reach the surface in the barrens, in the north part of section 23, and at other points, also in the timber on the northwest side of Mud prairie, near the middle of the west line of section 36, toward the center of section 25, township 3, range 2, and in the southwest quarter of section 30, township 3, range 1. At the edge of the prairie, near the south line of section 30, shales have been struck in wells.

At and near Coloma, on the eastern edge of Mud prairie, the sandstones crop out in several ravines in the north part of section 33, township 3, range 1. Little Muddy river is only three-fourths of a mile east of the station. The barrens east of the creek are evidently underlaid with the sandstone formation, although no outcrops are found in the southeastern corner of the county, except on the Little Muddy itself. These sandstones, partly in thin layers, partly in heavy beds, are found at several points from the county line northward, in sections 34 and 27. Much sandstone has been quarried near the middle of the west line of section 27, and in the northeast quarter of section 28, especially for building the railroad bridge, a mile farther north. It forms heavy layers, and works well, but is mostly rather soft. It is of fine grain, light-grayish, or yellowish-gray colors, mostly full of minute brown ferruginous spots, and small scales of silvery mica. Some portions of the rock are bluish-gray, and very hard. It is interstratified with arenaceous shaly layers. In the southwest quarter of section 22, sandstone forms the bed of the stream; but, a few rods farther north, the

bank is formed of black laminated slates, with a thin intercalated ledge of dark-colored slaty and highly fossiliferous limestone. A little farther up, at the railroad bridge near the west line of section 22, the bank, about twenty-five feet high, consists of bluish-gray slaty shales. Some distance above the bridge, I observed, in a similar bank, about fifteen inches of dark-colored slate, containing two thin seams of coal, each from one to one and a half inches thick. A little higher up the creek, in the northeast quarter of section 21, the shale dips gradually to the northward, and a heavy ledge of limestone, underlaid with some black slate, is seen in place above it, and soon reaches the level of the creek. Half a mile to the westward, in the north part of section 21, the coal is again exposed on a branch, a short distance below the same limestone, forming here also a regular seam of eight inches of good coal. Farther north, the limestone rises again, in consequence of an undulation of the strata, but I am not satisfied whether the lower strata reach the surface in that direction.

The Shoal Creek Limestone.—This limestone, which overlies the formation described in the foregoing pages, is a light-bluish-gray or yellowish-gray limestone, with subconchoidal fracture and subcrystalline texture, hard, and somewhat siliceous or argillaceous. It occurs partly in beds eighteen inches or more in thickness, partly in thin ledges from two to four inches thick, with either an even or uneven surface. Its aggregate thickness varies between four and ten feet, and is generally about seven feet. It works well as an ordinary building rock, is of great value for foundation walls, and can be burned to a dark-colored but strong lime. Of fossils, it contains the following species: *Productus longispinus*, *Chonetes mesoloba*, *Retzia Mormoni;* also, *Productus costatus? P. Prattenianus*, *Spirifer cameratus*, *S. planoconvexus*, *S. Kentuckensis*, *Athyris hemipronites*, *Rhynchonella Nautilus*, etc. In shales and slates closely allied to it, we observed, besides these, at least five species of *Bellerophon*, three species of *Macrocheilus*, several species of *Pleurotomaria*, *Euomphalus*, *Nucula*, *Orthoceras*, etc.

We find this limestone at various points in a zone extending from northwest to southeast through the middle of the county, overlying the above described rock, which crops out southwest of it; and it is succeeded by higher beds toward the northeast. It thus furnishes evident proof of the general northeastern dip of the strata it this county; but the relative position of its outcrop shows most conclusively that the dip is not quite regular in one direction, but somewhat undulating. Thus, Little Crooked creek runs in a depression of the strata, while

the rocks rise east and west of it; and we shall point out other irregularities of this kind in the course of the description of the single outcrops. The same feature is very prominently developed in connection with the same formation in Clinton county.

I have already stated that large masses of the Shoal Creek limestone were found tumbling in the bank of Kaskaskia river, just above the Stone Coal Ford, not far from the line between ranges 3 and 4, and also at the head of a little creek about a mile south from there; so that it seemed as though the rock must be in place in the upper part of the hills. It was, however, first found actually in place over two miles farther east, in some wells in the prairie, near the center of section 16, in the northwest quarter of section 16, township 1, range 3, and on the east side of section 9, at depths from sixteen to twenty-four feet; and it crops out close by, on a ravine just below the level of the prairie, at Mr. Holmes', in the northeast quarter of section 16. The upper layers, which are here alone exposed, are each from three to four inches thick; the lower ones appear to be heavier, and the rock is fine for building purposes. A mile farther east, the limestone forms the bank of Little Crooked creek, in the northeast quarter of section 15, and is between seven and eight feet thick. It here contains a small cave, with a spring which undoubtedly drains some sink-holes west from there in the low hills, and is noted in the early history of the country for an Indian massacre. The limestone is also exposed a mile farther northeast, on a ravine a short distance west of the creek, in the northeast quarter of section 11, and two miles east of Little Crooked creek, on a ravine in the prairie near the Lutheran church, and in the southwest quarter of section 18, township 1, range 2, considerably above the level of the creek. At the latter point, the limestone is of grayish color, and apparently over six feet thick. The church, a stately edifice, has been built of it. In digging a well at the church, the limestone was struck at a depth of eighteen feet, three feet thick; the upper layers of it had probably disintegrated. Then, several feet of black slate were found, which generally follows underneath the limestone, and occasionally contains faint streaks of coal; but here it was surrounded by arenaceous, shaly strata. The wells in this part of the prairie are generally shallow, and the water is obtained from the surface deposits; but, southwest of the church, toward the edge of the prairie, in the west part of section 24, and in section 23, township 1, range 3, black slates are said to have been struck in the wells at several points, which are apparently those underlying the limestone. Farther northeast, in the northwest quarter of section 5,

township 1, range 2, the limestone is said also to have been struck in somewhat deeper wells, but I could not obtain satisfactory information in relation to it. On Crooked creek, in the north part of section 28, township 1 north, range 2, I noticed at the foot of high banks of yellow clay, drift-boulders, with pieces of sandstone, and some large blocks of limestone similar to the Shoal Creek rock; and it is said that, a short distance higher up the creek, its bed consists of solid rock (which could not be seen at the time of my visit), supposed to be limestone. It would therefore seem as if the Shoal Creek limestone did outcrop thus far east; still, I am not positive about it. A mile farther east, higher sandstones were found.

Turning southward again, we find no exposure of the limestone for a considerable distance. It is said to form the bed of Little Crooked creek, near the forks of the Middle and Nashville branches, in the northwest quarter of section 35, township 1, range 3, and that of Middle branch east of the center of section 6, township 2, range 2; but the higher sandstone formation occupies the uplands north and south from there, and the next point, where it is more prominently exposed, is at the head of Rock branch, a tributary of Middle branch, just below the edge of the prairie which forms the main dividing ridge, in the center and northwest part of the northwest quarter of section 9, township 2, range 2, where it has been extensively quarried. There the limestone is seven feet thick, in ledges from three to eighteen inches thick, and rests upon three feet of black laminated slate, which contains a little coal. It crops out once more a mile farther east, in the northwest quarter of section 10, in a similar position; but then the higher sandstones succeed, which are also found north and south of the two last named points. The dip of the limestone from Rock branch to Little Crooked creek is therefore to the northwest; but from the former point it changes again to the northeast.

The most westerly point where the Shoal Creek limestone has been observed in this county is on the high ridge six miles northwest of Nashville, in the west part of section 7, township 2, range 3. There, limestone and sandstone are reported to have been struck in several wells, which, to all appearance, must be the Shoal Creek limestone, and a sandstone close above or below it. A mile farther east, near the northeast corner of section 18, this limestone was again struck, on the summit of the ridge, at a depth of thirty or thirty-five feet, while, in another well close by, a sandstone was found at twenty feet, which seems to overlie the limestone. On the same ridge, near the middle of the south half of section 17, the limestone is thirty-

five feet under ground, covered with twenty feet of shales. Close by, on lower ground, in the southeast quarter of section 17, a shaft was sunk in 1857, to the depth of eighty-six feet, in the unwarranted expectation of finding a heavy layer of coal at a small depth. The Shoal Creek limestone in this shaft was seven feet thick. Above it there was shale; below it, black slate; then shales and sandstone. Nine inches of coal was found at a depth of eighty-two feet, most likely the same seam which crops out at the Stone Coal Ford. North of these points no rocks are exposed for several miles, but the limestone probably continues uninterruptedly to Crooked creek. Southwestward the ridge falls off rapidly, and the limestone cannot extend much farther in that direction.

The only outcrop of limestone in this vicinity is at the head of Willow branch, near the summit of the dividing ridge, at Mr. Balderson's, near the southeast corner of section 20, where it is quarried extensively; and also on the southwest quarter of section 21. It is there about eight and a half feet thick. The upper two feet consist of thin plates of limestone, mixed with shale; the lower six feet form heavy layers. Below it follow a few inches of shale; then three and a half feet of black laminated shale, and then sandy shales more or less slaty.

A mile and a quarter farther east, in the southwest quarter of section 22, and in the northwest quarter of section 27, the limestone has also been struck in several shallow wells, on the high ridge; but thence it seems to dip strongly to the northeast. Near the southeast corner of section 15 it has been found in a well on much lower ground, and at Nashville it lies at a considerable depth.

Nashville is situated in the northeast part of section 24, township 2, range 3, near a branch of Little Crooked creek, on the northern slope of the ridge. I will not now speak of the uppermost formations there which overlie the Shoal Creek limestone, but I will give the section of the shaft which was sunk by Mr. Huegeli, near his flouring mill, on the lowest upland adjoining the creek bottom. The shaft was sunk two hundred and thirty feet deep, and then two hundred feet more were drilled down. The work was stopped in 1862. The following is a closely approximate section, for which I am indebted to the courtesy of Mr. Huegeli:

Section of Strata in Mr. Huegeli's Shaft, at Nashville, on the southwest quarter of the southeast quarter of Section 13, Township 2 south, Range 3 west.

No.		Feet.
1.	Soil and drift clay	11
2.	Shale	4
3.	Arenaceous limestone	3

4.	Sandstone and shales	62
5.	Hard blue limestone—Shoal Creek limestone	7
6.	Black laminated slate, with streaks of coal	3½
7.	Sandstone	13
8.	Clay shale	15½
9.	Gray and brown fossiliferous limestone	1
10.	Black shales, with fossils	9
11.	Coal, 14 inches	1⅙
12.	Sandstones and shales	70
13.	Limestone [areno-calcareous conglomerate?]	7
14.	Coal, 8 to 10 inches	0¾
15.	Shales	22
	Bottom of shaft	230

Below this a boring was carried down two hundred feet from the bottom of the shaft; one hundred and seventy feet reported to be shale, and the lower thirty feet alternations of limestone and shale, probably the beds overlying the DuQuoin coal.

At various depths concretions of carbonate of iron (kidney ore) were found in the shales. It is a great pity that the work was abandoned at that point, when very little more work would have settled the question whether the DuQuoin coal extends that far, and with what thickness, for the boring must nearly have reached the base of the limestone above the coal. The shaft is only covered, not filled, and the drill-hole is probably still open, at least part of the depth. The work could probably be resumed at a small cost, and the boring ought to be carried deeper by all means. By boring from twenty to fifty feet deeper, the chances of obtaining coal at that point, from the DuQuoin seam, would be positively settled.

At the south side of the dividing ridge, the Shoal Creek limestone was next discovered at the head of Watering branch, in a ravine near the edge of the prairie, in the middle of the east half of section 31, township 2, range 2. Farther down the branch, still in the southeast corner of section 31, large tumbling masses of it were observed, which seem to be very little moved from their original position, and they are associated with blocks of a calcareous sandstone, full of fossils, which seems to correspond to the Joliff's mill rock. If the latter rock is in place in the upper part of the hills in this vicinity, it would seem as if the limestone had a local dip to the southward, and, indeed, about a mile lower down, at a sharp bend of the creek, near the northwest corner of section 8 (?), township 3, range 2, large blocks of the limestone were once more observed in the bank, fully four feet thick. The branch valley is there only a few yards wide, and has apparently been hemmed in by the limestone which thus seems to be in place a few feet above the water-level. The lower sandstone formation begins to crop out some distance farther south.

On Beaucoup creek, the Shoal Creek limestone is first exposed at the water's edge, on the northeast corner of section 27, township 2, range 2. It probably reaches a short distance higher up the creek. Down the creek, it continues in the hillsides, gradually rising above the water level, and crops out on the west side of the creek, at numerous points in sections 27 and 34, and in the northeast quarter of section 3, township 3, range 2. It has also been struck in various wells at the eastern edge of the prairie in section 34, and in the southwest corner of section 27, at a depth of twenty-two feet. The limestone here is partly blue, partly grayish, and on the outside frequently brown. It is at least seven, and probably ten feet thick, and rests on black laminated slates and arenaceous shales.

We find it next several miles farther southeast, in the barrens near the Little Muddy, near the middle of the north line of section 17, township 3, range 1, and at several points in or near the southwest quarter of section 9. It is here over eight feet thick, is underlaid with black slate, and dips eastward, toward the Little Muddy. In a well on the ridge near by, only three-eighths of a mile from the creek, the sandstone which overlies the limestone has been struck at a depth of only six feet, and in a ravine close by, some eighteen feet of it is exposed in one bluff. The sandstones and shales higher up on Little Muddy, especially in section 4, evidently belong to the higher formations, and the limestone seems first to strike the creek in section 9, but is exposed only in its banks southeast of the center of section 16, where it begins a few inches above the water level, and forms a low bluff. It holds a similar position a few rods farther east, but then it is seen rising southward and westward. Near the south line of section 16, it caps a low bluff on the creek; and, still lower down, above the railroad bridge, it is only found in tumbling masses at the foot of high exposures of lower strata, while on a ravine west of the creek, in the northwest quarter of section 21, it has once more been observed in the barrens. East of Little Muddy, limestone is said to have been discovered, in digging a well, twenty-two feet below the surface, in the timber on a branch of Little Muddy, considerably below the level of the prairie, in the northeast quarter of section 11, township 3, range 1; but this may have been a higher ledge of hard sand-rock. Three-quarters of a mile north of Richview, it has also been struck in sinking a shaft close to the Illinois Central railroad, near the north line of section 2, township 2, range 1, at the edge of the high prairie. Judge Phillips, of Richview, to whom I am indebted for the information in relation to this undertaking, states that the limestone was found at a depth of

about one hundred and twenty feet, from six to eight feet thick. Then followed downward, below the limestone:

Black slate	3 feet
Fire-clay (argillaceous shales)	8 "
Stone coal	4 inches
Fire-clay (shales)	4 feet
Sandstone	31 "
Slaty rock	7 "
Black slate	2½ "
Shale	8 "

No exact data could be obtained for the rest of the work. The shaft was sunk to a depth of two hundred feet, and then they bored sixty feet deeper; but no journal was kept of the strata penetrated.

The Upper Sandstone formation.—The most westerly point where any strata were observed above the Shoal Creek limestone, was at the trial-pit on the ridge some miles east of Nashville, in section 17, township 2, range 3, and in some wells northwest of it. They consisted of sandstone and shales, the latter apparently arenaceous, and were not more than about twenty feet thick.

Near Nashville, we find this formation much more largely developed. In the shaft at the lower end of the town, sixty-nine feet of this formation were passed through, and it forms part of the high hills north of town. In the shaft, we find next above the limestone sixty-two feet of shales, sandy shales, and shaly sandstones, and then three feet of a "bastard limestone," and four feet of shales underneath eleven feet of soil and clay. The bastard limestone was a hard rock, apparently a mixture of sand and lime, and I am strongly inclined to the opinion that it corresponds to the Joliff's mill rock, on Crooked creek, mentioned below. On Little Crooked creek, a short distance southeast of the shaft, near the south line of section 13, the bank consists of about fifteen feet of soft sandstone, which contains some thin irregular streaks of stone coal, varying in thickness from that of a knife-blade to over four inches. This sandstone has been struck in several wells in the east part of the town, southeast of the shaft, and also in one a short distance southwest of the shaft, where it reached from ten to twenty feet below the surface, and it is therefore very strange that no trace of it has been found in the shaft. In the western part of the town, which is higher, shales are struck in digging wells, and water is not so readily obtained. Shelly sandstones and shales are exposed in a ravine on the hills south of Nashville, which form the dividing ridge near the middle of the north line of section 25, township 2, range 3; and in a well on a high point in the southeast corner of section 25, shaly strata were struck; these latter may, however, be

really lower strata of this series, which have risen to this altitude in consequence of the inclined condition of the strata.

From Nashville eastward, this sandstone formation extends over the dividing ridge, and thence northward, over the uplands, to Crooked creek. The wells on the ridge generally do not reach down to rock; still, the sandstones have been found at sufficiently numerous points to trace their extent. They have been struck in wells at the western edge of the prairie, between the Nashville branch and Middle branch of Little Crooked creek, on rather low ground, in the northeast quarter of section 18, township 2, range 2, at a depth of only fourteen feet; and at the northwestern extremity of this arm of the prairie, in the south part of section 1, township 2, range 3, at sixteen feet, where it is hard and bluish in color. Then it has been struck on the high prairie in section 16, township 2, range 2, and in the southeast quarter of section 10; also, farther south, at the edge of the prairie towards the Beaucoup, in the southeast quarter of section 15, in section 24, and as far as Judge Phillips', in the middle of the west half of section 27. There, in a ravine below the prairie, thinly stratified shelly sandstones are exposed above the Shoal Creek limestone, and the sandstone crops out also a mile farther north, on a branch of Beaucoup creek, not far from the main stream, in the northeast quarter of section 22. It undoubtedly underlies the barrens between the head of Beaucoup and Little Muddy creeks, in the eastern part of which it has been quarried in section 30, township 2, range 1, and has been struck in a well in section 6, township 3, range 6. In the adjoining so-called "dry arm" of the prairie, I am informed it is difficult to obtain water, and sandstones have been struck quite shallow at its west side, near the southwest corner of section 29, township 2, range 1, and farther south, and also in the southwest quarter of section 28, and at other points. On the upper course of the Little Muddy, near Ashley, the sandstones still prevail, but no rocks are exposed on it higher up than the southwest quarter of section 34, township 2, range 1; and thence downward, at intervals, to the north part of section 9, township 3, range 1, the first outcrops consist of sandstones, the next, of bluish-gray argillaceous slate, and the lower outcrops, of arenaceous shale, with concretions of carbonate of iron.

Returning northwestward, we find that gray indurated shales were struck in a well at the edge of the high prairie, at the head of Middle branch of Little Crooked creek, in the southeast corner of section 1, township 2, range 2. Soft and partly shaly sandstones crop out on the branch in the southeast quarter of section 2, and in the north-

east quarter of section 3, and are also found exposed in the barrens a mile and a half farther west, south of the branch, in the northwest quarter of section 4. North of Middle branch, near the northeast corner of section 6, the shaly sandstones were also struck at the edge of the prairie, and penetrated to a depth of thirty-two feet; this is the most westerly point where they have been discovered north of this creek. Sandstones were also found in wells in this part of Grand prairie, near the south line of section 35, township 1, range 2, in the northwest corner of section 35, in the southwest quarter of section 27, in the west side of section 21, in the southeast quarter of section 16, and at some other points. In most of these wells water is, however, obtained either before striking the rock or after digging a few feet into it. Slaty rocks were discovered in other wells farther east, near the northwest corner of section 26, and in the southwest quarter of section 24, where a thin seam of coal is said to have been found between them, and west of Hoyleton, in the northwest quarter of section 14, where they rested on shaly sandstones. More sandstones were then struck farther east, in the high prairie, in the northeast quarter of section 30, township 1, range 1, from whence they seem to continue to the head of Grandpoint creek, and in the middle of the east half of section 24, township 1, range 2, where a well was dug forty feet deep, mostly through soft shelly sandstone, without getting water. A mile and a half farther northwest, at Hoyleton, in the northwest quarter of section 13, sandstone and shaly rocks are struck at the bottom of wells which are seldom more than twenty feet deep. North of Hoyleton, the prairie is lower, and the first traces of this formation have been found in a well on the low hills near Crooked creek at the northern edge of this prairie, on the east side of section 27, township 1 north, range 2, and farther east, they consisted of arenaceous shales or shaly sandstones.

The first conspicuous outcrop of rocks on Crooked creek is in the northeast quarter of section 25 (?), township 1, range 2, at an old saw-mill, called Joliff's mill. The principal ledge there is a finely-grained grayish-blue calcareous sandstone or mudstone, with a brown surface. It is not uniform throughout. In some places it is more arenaceous—a hard sandstone; in others, more slaty. It is from two to two and a half feet thick, and contains numerous fossils, especially *Productus Prattenianus*, *Pinna per-acuta*, together with *Myalina*, *Spirifer*, and many others. It is underlaid with a few feet of arenaceous shaly strata. A quarter of a mile higher up the creek the same strata crop out again. This calcareous sandstone does

not appear to be exposed anywhere else in this county; but I have found tumbling fragments of rock, closely corresponding to it, with the Shoal Creek limestone at the head of Watering branch, and also on the upper course of Little Muddy river. I presume it is the same stratum which, in the section of the Nashville shaft, has been designated as No. 3—a "bastard limestone"—and is there sixty-two feet above the Shoal Creek limestone, forming an intercalation in the sandstones and shales of the upper Coal Measures.

At the edge of the prairie which overlooks the Crooked creek bottom, half a mile southeast of the exposure described last, on the southwest quarter of section 30, township 1 north, range 1, sandstone and shales are struck in wells, and also southeast from there, in the prairie, in the southeast quarter of section 31, while most of the wells do not penetrate to the rocky substrata.

On the lower course of Grand-point creek, there is only one outcrop, three-fourths of a mile from its mouth, in the south part of the northwest quarter of section 29, township 1 north, range 1. It consists of shales, containing thin shells of hard sandstone. Then there are no more exposures on the creek, and only here and there a high bank of clay, with drift-boulders and a few tumbling rocks, until we reach its upper branches. On these I observed some small outcrops of sandstone at a few points, in the southwest quarter of section 28, the northwest quarter of section 27, and the southwest quarter of section 23, township 1 south, range 1, and in the east part of section 5, township 2, range 1. The rock is mostly thinly stratified and intercalated with shales. Such sandstones were also noticed near an eastern branch of the creek, on a ravine, in the northwest quarter of the northeast quarter of section 1, township 1, range 1, and on the west side of the Illinois Central railroad, not far from the base line; while on the creek, half a mile farther northwest, in the southwest quarter of the adjoining section (36), loose slabs of a highly cemented, hard, blue, calcareous sandstone were observed. Near Irvington, in the southwest quarter of section 12, township 1, range 1, sandstone has been quarried on the high prairie. At Irvington, water is obtained in the Quaternary deposits; but on the lower ground, a mile farther west, shales have been struck at a depth of eighteen feet, and on the prairie hill, half a mile northeast of the station, a thin seam of stone-coal, said to have been twelve inches thick, has been penetrated in digging a well. This is probably the same coal which has been discovered at other points farther east, northeast and southeast, and which is intercalated in the upper sandstone formation.

On the high prairie ridge, south of the head of Grand-point creek, and west of Richview, the sandstone has also been struck in several wells. At some points the water is obtained above any rock, and at others under a few feet of soft sandstone, which generally reaches to within ten feet of the surface. At still others, the rock has been penetrated more than ten feet without getting water.

The old town of Richview lies on this ridge, round the center of section 10, and is underlaid with the sandstone, which crops out in the ravines in the northeast quarter of section 10. The station and new town are situated in the southwest quarter of section 2, township 2, range 1.

Shelly soft rock and arenaceous shales crop out at various places in the branches above and below the town, in the southeast quarter of section 3, in the north part of section 11, and in section 12, on a branch of Big Muddy river, where the rocky bluffs are in places more than thirty feet high; also on smaller ravines farther south, in sections 11 and 14. In a ravine west of the town, I noticed at one point, together with drift-boulders and tumbling sandstones, a large amount of fossiliferous limestone, similar to limestones which occur farther southeast, in connection with a thin coal seam. It is, perhaps, in place in a hill, and, being a thin layer and partly soft, is not prominently exposed. The sandstones were also found exposed northeast of Richview, below the edge of the prairie, in a ravine in the northwest quarter of section 2, and have been struck in wells northeast of the center of section 36, township 1, range 1, and again half a mile farther northwest, just beyond the county line.

Ashley is situated at the edge of the prairie, on the north side of section 27, township 2, range 1, mostly in the northeast quarter of the section. Water is obtained at some points above the rocks, at a depth of from twelve to twenty feet; but usually the sandstones are struck in digging wells, and they crop out at several points some distance east and northeast of the town. At the edge of the prairie southeast of Ashley, in the southwest quarter of section 26, and in section 35, the wells are generally a few feet deep in shelly sandstone, which has also been struck in the prairie in the south part of section 25, while on a higher hill, near the center of the north half of section 36, shales were found in a well. Half a mile east of the county line, in Jefferson county, I observed considerable outcrops on branches running eastward. At Mr. Hunter's, in the northeast quarter of section 7, township 3, range 1 east, a seam of stone-coal, from eight to twelve inches thick, was noticed just below the edge of the prairie. It is capped with arenaceous shales, and

is also underlaid with two feet of the same, below which follow several feet of sandstone, and then arenaceous shales. The sandstones are of a fine grain, and firm, partly ripple-marked, and partly in smooth ledges, which form a very desirable building material, and are used as such at Ashley. Some traces of black slate were noticed with the coal. A short distance lower down the bank I noticed, intercalated in shales, large slabs of fossiliferous limestone, perhaps the same of which I had seen indications near Richview. The coal is also exposed in other ravines farther southeast. The sandstones are also exposed in a ravine a mile farther north, in the north part of section 6, and the limestones and shales a short distance lower down. The heaviest slabs of the limestone measured eight inches, while I noticed much thinner shells of the rock in the shales. Two and a half miles farther northwest, and nearly east of Ashley, in the southwest quarter of section 24, township 2, range 1 west, I observed the same sandstone on a ravine in the edge of the timber, partly in fine ledges, partly shelly, and, lower down, shaly outcrops, and also large slabs of the above-mentioned limestone. Traces of the coal are said to have been found farther northwest, in section 23 or 14.

Economical Geology.

Coal.—We have seen that the geological formation of Washington county is that of the upper part of the Coal Measures. It contains several thin seams of coal, which are not of much practical importance, but may prove available at some points for supplying the local demand. Of much greater importance to the county is the question whether the lower Coal Measures, with their bountiful supply of coal, which is wrought in the adjoining counties, continue underneath the upper Coal Measures into and through Washington county; and if they do, at what depth, and whether their coal is undiminished in thickness, a question that can only be determined by boring or shafting down to the horizon of these coals in the lower measures.

The highest coal seam outcropping in this county, is one of its highest strata, and, therefore, found only on the east side of the county, and was found some miles southeast of Ashley, just beyond the county line; but it extends into Washington county, and probably through the hills, near Richview, and is apparently the same which has been discovered by Mr. Quick, near Irvington. The coal

is good, but is nowhere known to exceed twelve inches in thickness. It can, therefore, only be worked by stripping along its outcrop, where it can be conveniently exposed in ravines or on hillsides.

The next well-defined seam, and one which extends far beyond the limits of this county, is the one at the base of the slaty division, No. 3, of the county section, No. 11, in the Nashville shaft. It is found from fifteen to fifty feet below the Shoal Creek limestone, and appears to vary in this county between four and fourteen inches in thickness; but, near Highland, in the southeast part of Madison county, the same seam is eighteen inches thick, and has there been worked to a considerable extent. It is exposed at the Stone-coal ford, on the Okaw river, in the southeast quarter of section 1, township 1, range 6; and was found in the trial-shaft four miles west of Nashville, in the southeast quarter of section 17, township 2, range 3; also, in the Nashville shaft, in the southeast quarter of section 13, township 2, range 3; then, on the upper course of a branch, in the southwest corner of section 5, township 3, range 2; on Beaucoup creek, and also on a branch in the southwest quarter of section 35, township 2, range 2; and near Little Muddy creek, in the north part of section 21, township 3, range 1.

The next, and more extensively but very irregularly developed seam of coal, is in the upper part of the lower sandstone formation. As far as known, it nowhere attains a thickness of more than twelve inches, and is mostly thinner. It crops out at various points on Mud creek; and the coal on the east side of Elk prairie, three miles northwest of Elkton, is perhaps the same.

From the foregoing statement, we see that the supply of coal in the county mainly depends upon the prospects in the lower Coal Measures. The question whether they extend into the county, must be answered with a decided yes. There can be no doubt about it. The limestones and shales which have been struck at Nashville, beginning at a depth of four hundred feet, must be the Belleville limestones. All the strata which have been observed outcropping between the next exposure of these limestones and Nashville, have also been penetrated successively in this shaft. Another question is, whether the coal which underlies this limestone formation in St. Clair and Perry counties, also extends under Washington county. This question has not yet been decided by experiment, but we have again to answer yes, in all probability. There is no reason for supposing that it was not so, while the great regularity with which this coal is known to extend under an area many miles in length

and width, would seem to warrant our expectation to see it continue farther.

The depth to the Belleville coal would probably be at Nashville about four hundred and forty or four hundred and fifty feet; that is, three hundred and sixty or three hundred and seventy feet below the Shoal Creek limestone, which begins in the Nashville shaft at a depth of eighty feet. As we know the range of this limestone in the county, we can approximately determine the depth to the coal at other points, although the thickness of the strata is subject to great variations. The depth would be least in the northwestern and western part of the county, and greatest in the northeastern part. At Richview, where the Shoal Creek limestone lies one hundred and twenty feet below the surface, it would probably be four hundred and eighty to five hundred feet or more to the Belleville coal. This is only half of the depth at which coal is successfully and profitably mined in England. If the demand for coal is sufficiently large to warrant the investment of a large capital, and the employment of a large number of miners, then the obstacles of mere depth can be readily overcome.

Minerals.—No valuable minerals have been discovered in Washington county. The shales of the Coal Measures, at various depths, contain much iron ore, in the shape of concretions of carbonate of iron, the so-called kidney-ore; but I have not seen one point where it would seem to occur concentrated in sufficient quantity to be useful as an iron ore.

Building Materials.—The county is amply supplied with building materials of various kinds—sandstones, limestones, sand and lime—while brick can be manufactured anywhere. Timber is also still to be found in sufficient quantity, as nearly half of the county is timbered land, and much of it is of superior quality.

Agriculture.—In discussing the general character of the county, I have already pointed out the great similarity between it and Perry county. Its prairies, post-oak flats, oak barrens and timbered hills correspond closely to those described in the report of Perry county; and all that has been said in regard to them is also applicable to Washington county. The similarity is far less with St. Clair county, where, in may respects, different conditions prevail; and the counties farther north and northeast, along the Ohio and Mississippi Railroad, have also a somewhat different character of their own.

On the upper courses of the creeks we find, generally, much locust, elm, black walnut, red bud, etc., and, in the prairies, willow. Lower down, the bottoms, which are mostly subject to frequent overflows,

are mainly timbered with white oak, swamp white oak, bur oak, elm, sugar maple, sycamore, red bud, pawpaw, pignut hickory, scaly-bark hickory, some laurel oak, and at more wet points, with water-oak and honey locust.

The agricultural value of the lands in this county is shown from the above statements. While they do not rank generally with the richest in the State, they are mostly of very fair quality, many of them far above the average; and, when properly cultivated, lands of this kind are more enduring, and yield better in the end, than the flat, wet prairies which are richer in humus.

CHAPTER VI.

CLINTON COUNTY.

BY HENRY ENGELMANN.

Clinton county is bounded on the south by Washington county, on the west by the northern part of St. Clair and the southern part of Madison counties; on the north by Bond county, and parts of Madison and Lafayette counties; and on the east by Marion county. It embraces townships 1, 2 and 3 north of the base line, in ranges 1, 2, 3, 4 and 5 west of the third principal meridian, with the exception of township 3, range 5, which forms part of Madison county, and of portions of township 1, ranges 1, 2 and 3, which belong to Washington county; instead of which is added the northwestern part of township 1 south, range 5. While the western, northern and eastern boundaries follow the township lines, the line which separates Clinton from Washington county is formed by the Kaskaskia river, from the St. Clair county line to the mouth of Crooked creek, then by the latter to near the mouth of Grand-point creek, whence it runs due east to the meridian line, along the section lines, two miles north of the base line. The county thus includes an area of nearly fourteen townships, or about four hundred and eighty-seven square miles, the larger portion of which is prairie.

This county is well watered, first by the Kaskaskia river, which passes from north to south through the whole width of the county, east of the center, and then forms its southern border; then in the western part by tributaries of the Kaskaskia, running parallel to the upper course of the main stream, from north to south; then by Sugar creek, and by Shoal creek and its tributary, Beaver creek. In the eastern part of the county, the branches, on the contrary, trend more towards the west or southwest, and are the East Fork

in the north and Crooked creek in the south, with its tributary, Lost creek, and some others of minor importance.

Along the principal water-courses we find timber bottom lands, and more or less wide belts of timbered uplands, while the intermediate uplands are prairies. In the western part of the county, long prairies, extending from north to south, alternate with belts of timber. They generally decrease in altitude towards the lower course of the streams. The eastern part of the county is, however, much flatter, and timber is scarce, except along the main streams, the East Fork and Crooked creek, and diminishes rapidly on the smaller branches. Although some of these are many miles in length, and drain large areas, they have the appearance of mere prairie drains. East of the Okaw timber, the county is mainly prairie, and rather uniform and comparatively low and wet.

The prairies are in part similar to those of the adjoining county of Washington, especially in the eastern part of the county; but we find here also a class of prairies which were not observed there—the low bottom prairies, like the Santa Fé prairie, in the principal bend of the Kaskaskia river. There is no definite land-mark between that prairie and the river bottom—no elevated bank whatever; and the bottom timber gradually yields to the grasses, so that there is an intermediate district occupied by oak-openings, where patches of prairie alternate with clumps of trees, mainly consisting of the water oak. Most of this prairie is so wet that it is covered with the coarsest grasses, and absolutely needs artificial drainage before it can produce the ordinary crops. The uplands proper begin only at the northwest side of this prairie, along which a line of hills extends across the bend of the river, at the foot of which the latter, perhaps, once had its bed.

I have noticed such oak openings also at various other points, especially along the east side of the Okaw timber, toward Grand prairie. They often form a sort of a second bottom, only a very little elevated above the heavily timbered bottom. Their principal growth appears to be the pin oak or water oak, while at other points we observe also much laurel oak, especially where the ground is somewhat higher, and forms the margin of an upland prairie. These openings are by no means confined to low ground, but occur also on the highest prairies; for example, at the south end of Carlyle prairie, east of Shoal creek.

Grand prairie, east of the Okaw river, differs somewhat from those heretofore described. In other prairies, wherever we found a ravine of any size, we found along it its timber belt, which intersected the

prairie. Here, creeks many miles in length, which at certain seasons discharge vast volumes of water, appear only as slightly depressed prairie drains, the course of which is hardly marked by a few bushes. This is due partly to the flatness of the land; but the changed quality of the soil is not without its influence in this respect. The sub-soil in this part of Grand prairie, and at some points farther west in the county, consists of a thick layer of hard-pan, which differs in thickness, and also in quality, from any hard-pan in the sub-soil which I have observed in the counties farther south. It forms a prominent feature in the prairies of this part of the State, and exercises a leading influence upon the agricultural value of the lands.

The timber in Clinton county is still of the same type as that farther south, in Washington and Perry counties; and the only existing differences are produced by the gradual change of the surface configuration. The post-oak is still extensively distributed, and we even find some regular post-oak flats, with white soil and level surface, covered with post-oak and black-jack, and a few black-oak. It is thus on the Ohio and Mississippi Railroad, between Shoal and Beaver creeks, and also north of Santa Fé prairie, near the northeast and southeast corners of the county. The post-oak also prevails in the belts of timbered upland, along the streams, and at some other points, together with black oak, some white oak, black-jack, barren hickory, pignut hickory, and, in damp places, water oak, laurel oak and locust, and at the edge of the prairies we find the crab-apple and wild plum.

The bottom timber of course varies with the different characters of the bottoms. It is generally quite heavy. The water-oak is most abundant, together with the swamp white-oak; but then we find also much bur oak, red oak, and at dry points even white oak; also black and white walnut, silver maple, locust, sycamore, white and red elm, pignut and shell-bark hickory, box elder, red bud, hazel, haw and other trees, and, on the Kaskaskia, also some cottonwood.

Geological Formations.

The geological formations of Clinton county consist mainly of the upper Coal Measures. They form the continuation of the strata which we have found in Washington county, especially of their upper portion, and overlie those exposed in St. Clair county, including the lower Coal Measure and Belleville coal.

In Clinton county, we find some thin strata of coal in these upper Coal Measures, which might be advantageously worked at some points by stripping along their outcrops, and thus supply a limited local demand. The main reliance for a supply of coal, however, must be placed upon the coal of the lower Coal Measures, which can only be reached at a considerable depth by extensive mining operations. I have no doubt that the lower coals continue from St. Clair county eastward, and extend at least under a part, if not under the whole of Clinton county, although at an eastwardly increasing depth. If this is the case, it can be made accessible, whenever the demand renders its exploration necessary and warrants the investment of a sufficient amount of capital to prosecute mining operations on an extended scale.

The following is a section of the strata of Clinton county, in descending order:

1. *The Upper Sandstone Formation*, corresponding to the formation of the same name in Washington county. It appears to consist, in Clinton county, mainly of shales, many of which are arenaceous and full of concretions of carbonate of iron, interstratified with thinly-bedded sandstones. This formation, as developed in this county, presents several calcareous intercalations, especially one near its base and another one in its upper portion. Of these, none contain sufficient lime to form a heavy layer of limestone; but it is combined with the prevailing material of the formation to form calcareous sandstones, calcareous mudstones and calcareous slates, or it forms only calcareous concretions in the other rocks, which seem to be continuous over extensive areas. In the upper part of the formation, a seam of coal has been observed at different points, from ten to twelve inches in thickness, in close proximity to one of these calcareous layers. The upper sandstone formation occupies mainly the eastern part of Clinton county, beyond the Okaw river, but its lowest strata extend as outliers even west of Shoal creek. Its aggregate thickness has not been definitely determined, the exposure being too far apart and too small to afford a complete section of these strata, which, besides, are probably quite variable.

2. *The Shoal Creek Limestone.*—This rock corresponds very nearly to the description given of it in my report on Washington county. It is a light-colored, mostly light-bluish-gray limestone, with a fracture varying from sub-conchoidal to uneven, and a sub-crystalline and compact texture. Generally, it is hard and more or less siliceous, and at some points argillaceous. It sometimes forms layers of eighteen inches or more in thickness, sometimes thinner ledges,

and at most points quarries well, and is finely adapted for building purposes. Its thickness varies between six and eleven feet, and is generally about eight feet.

The Shoal Creek limestone contains numerous fossils, which, however, are somewhat difficult to obtain on account of the hardness of the rock. These have been already enumerated in the foregoing chapter, and the list need not be repeated here.

The name, Shoal Creek limestone, has been given to this bed because it is most prominently exposed in numerous outcrops on Shoal creek and in its vicinity, and we find there no other limestone with which it could be confounded. It occupies a large area in Clinton county, beginning in the northwest part of the county, at the St. Clair and Madison county lines, and extending along the north line at least to between Beaver creek and Okaw river, and farther south to the Okaw itself, and then even crosses it to Crooked creek; it does not, however, apparently reach into the extreme southwest part of the county, which is occupied by lower rocks.

3. *The Slaty Division.*—I retain this division as I have distinguished it in my report on Washington county. It embraces the strata between the Shoal Creek limestone and the lower sandstone formation, and consists mainly of slates and shales, and, in places, some sandstone, with a seam of coal of from ten to eighteen inches in thickness. Below the limestone we generally find some black laminated slate, frequently with a couple of feet of gray shales intervening between the two; then black or gray shales, or shaly sandstones; and finally the coal, with or without black slates above it. Of the limestone which I observed in Washington county with these strata, I hardly found a trace in Clinton county. The thickness of this formation also appears to be less, and to vary between twelve and twenty feet. Its whole thickness has, however, been observed only at a few points.

The black slates of this division, at some places, are rich in fossils, beautifully preserved in sulphuret of iron. Among them are, *Bellerophon carbonaria*, *B. percarinata*, and others; several species of *Marocheilus*, *Pleurotomaria grayvillensis*, *P. sphærulata*, *Euomphalus*, *Nucula*, *Orthoceras*, *Corals*, and fish-teeth.

4. *The Lower Sandstone Formation.*—This formation is hardly exposed in Clinton county, although it undoubtedly underlies the extreme southwestern part of it, immediately below the Quaternary deposits. The sandstones, which at a few points crop out underneath the Shoal Creek limestone, appear to belong to the slaty division. No shaft has been sunk in Clinton county from which a

correct section of this formation might be obtained, and I, therefore, refer to what I have said in relation to it in my report on Washington county. There it is two hundred and seventy feet thick in the shaft at Nashville, but its thickness appears to be variable. At some points it may be greater; at others, less; and I believe it to be less in the northeast part of Clinton county, because, in the coal shaft at Summerfield, only two and a half miles west of Clinton county, in which by far the largest part of this formation would seem to have been penetrated, it was found not more than one hundred and seventy feet thick.

Below the lower sandstone formation the Belleville limestone would follow, and the lower Coal Measures, with their main coal seams. As these have, however, not thus far been discovered in the county, the probability of their existence below the surface will be considered in what we shall have to say on the Economical Geology of the county.*

On Okaw river, as far as it forms the south line of the county, no outcrop of rocks whatever has been discovered, except at its south side, and therefore in Washington county, at the Stone-coal ford, a little west of the range line, between range 3 and 4. There, as has been described in the report on Washington county, we find in the bank of the river a few feet of argillaceous shales, and above them some ten or twelve inches of coal, and some black slates; also, loose pieces of a brown, highly-fossiliferous limestone, and large tumbling masses of the overlying Shoal Creek limestone. The river then appears to run through the slaty strata below the Shoal Creek limestone, which latter may be in place in the hills on the south bank of the river. Farther west, the Okaw river undoubtedly passes through the lower sandstones, but they are nowhere exposed, nor have they been struck in the wells on the low prairies on the north side of the river, which are all in the Quaternary deposits.

On the lower course of Sugar creek, no rocks are exposed; but in a well on the hills in the large bend of the creek, in the northwest quarter of section 3, township 1, range 5, the Shoal Creek limestone has been struck at a depth of hardly thirty feet, and at various points of that bend, in the north part of section 3, and in the south half of the adjoining section 34, township 2, range 5, large masses of this rock are found in the banks of that creek, which partly appear to be in place, while most of them are tumbling, or have at

*While these pages are in press, I am informed by Ad. F. Bandelier, Esq., of Highland, that coal, probably the Belleville seam, has been reached at Trenton, on the Ohio and Mississippi Railroad, in this county, at a depth of 310 feet. A. H. W.

least slipped down several feet from their original position in the higher part of the banks. It is evidently the obstruction presented by this rock which has caused the large bend of Sugar creek at this point. The limestone was also observed, apparently just slipped out of its original position, in the southwest quarter of section 27, township 2, range 5, and, also, in the southeast quarter of section 28. Fragments of black slate and coal were noticed occasionally on this part of the creek, and had evidently come from underneath the limestone, but may have been carried some distance by the water.

Near the middle of the east half of section 28, township 2, range 5, the Shoal Creek limestone forms the bed of Sugar creek, at the Rock ford, and is divided in large rectangular blocks by wide vertical fissures. The trend of the principal fissures is north of east, and that of the subordinate ones east of south. From this point the limestone rises in every direction, especially to the westward. A few rods farther north, the black slates which underlie the limestone form the bed of Little Sugar creek, dipping several degrees to the eastward; and farther up this creek, through section 21, above and below the railroad, and also in the southwest quarter of section 16, and in the southeast corner of section 17, near Trenton, and on a western branch in the northwest quarter of section 28, shales and shaly sandstones are exposed, which underlie the limestone and belong to the slaty division. The limestone has been quarried at a higher level in the west half of section 21, on the east side of Little Sugar creek, and also in the hills in the east part of section 22, south of the railroad. On the main creek it outcrops in this vicinity, and has been quarried extensively in a high bank south of the railroad bridge, in the southeast quarter of section 22 (?). There I observed, from the bed of the creek upwards: Six feet of black shales, partly gritty, with harder concretions; then, two feet of black laminated slate; two feet of gray shales, and six and a half feet of the limestone—the lower four feet in one heavy bed, and the upper two and a half feet in thinner layers. Higher up Sugar creek no more outcrops of rock occur in this county; but in the southwest part of Madison county, about two miles north of the Clinton line, the Shoal Creek limestone once more forms the bed of the creek, in the southeast quarter of section 21, township 3, range 5, and from this point also rises to the east and west.

West of Sugar creek, the limestone is exposed at a far more elevated point in Madison county, at the coal diggings north of Highland. At the latter town it has been penetrated in the coal-pit,

fifty-three and one-half feet below the surface. Nearly six miles farther south, just east of the point where St. Clair, Madison and Clinton counties corner, it is exposed in the bed of a ravine, near the head of a branch of Sugar creek, on the southeast quarter of section 31, township 3, range 5. In a well, close to the latter point, the underlying thin coal seam has been penetrated. Farther down on this branch we find only some outcrops of the slaty division of sandstone, near the west line of section 4, and of shales, at several points near to the main creek, while large masses of the limestone were noticed tumbling from the higher hills at different places.

At Trenton a coal-pit is being sunk on the railroad, in the southeast quarter of section 19, township 2, range 5. The Shoal Creek limestone does not reach that far west. The strata next the surface are those of the next lower slaty division. The following section was obtained there:

1.	Soil and yellow clay	27 feet
2.	Shales, partly arenaceous	8 "
3.	Black slate	2 "
4.	Consisting of 5 inches coal, 7 inches shale, 12 inches coal	2 "
5.	Shales	1 "
6.	Solid sandstone	4 "
7.	Shales and slaty shales	52 "
8.	Sandstone, alternating with shales	36 "

The shaft had attained a depth of one hundred and thirty-two feet at the time of my visit. The slaty division reaches to No. 5; the following numbers belong to the lower sandstone formation, which undoubtedly continues considerably deeper. The coal of the slaty division is seventeen inches thick in the shaft, in two layers. This coal has also been struck one and a half miles farther north, in a well at Mr. Rutherford's, near the northeast corner of section 18. The coal found in a well two miles farther southwest, half or three-quarters of a mile beyond the St. Clair line (at Mr. Utley's), may be the same, or else a lower seam. In the wells in the prairie south of Trenton no rocks are struck, and no clue obtained to the geological structure of the country.

East of Sugar creek the Shoal Creek limestone has been struck in wells at the edge of Shoal creek prairie, near the middle of the north line of section 36, township 2, range 5, at the depth of thirty-two feet, and southwest of the station at Hull, near the middle of the west line of section 24, at the depth of thirty feet; but no rocks have been struck anywhere else in this vicinity. Some miles farther north, near the southeast corner of Madison county, in the high rolling prairie, the limestone has been found in a well half a mile

north of that corner, and again half a mile farther north, near the southwest corner of section 30, township 3, range 4, at Mr. F. Blacet's, where it was eight and a half feet thick and thirty and a half feet below the surface. In a well near Sugar creek, on lower ground, in the northeast quarter of section 2, township 2, range 5, only tumbling limestone and slates were observed, while the rocks in places were lower strata, and mainly arenaceous shales. Close to the point where Madison, Bond and Clinton counties corner, on Mr. John R. Blattner's farm, in the high prairie, the limestone is also said to have been struck at a depth of sixty-two feet, and to have been twenty-two feet thick; but this is evidently a mistake.

In the central part of Shoal Creek prairie, throughout its whole length from north to south, no rocks have thus far been discovered in wells; but on the east side of the prairie, and on Shoal creek, we again find the limestone. About three miles east of the last named point, and half a mile south of the Bond county line, the Shoal Creek limestone crops out in a ravine in the prairie, in the middle of the east half of section 4, township 3, range 4, and has been struck in wells east from there, especially of Jamestown, near the middle of the west half of section 2, at the edge of the prairie, where it is about forty feet below the surface, and underlaid with slate. At the bridge over Shoal creek, still farther east, in the southeast quarter of section 2, the limestone forms the bed of the creek, and is here also divided in large rectangular slabs by vertical fissures, which cross it at right angles.

The coal of the slaty division underneath the limestone is exposed not far from Jamestown, a mile north af the Bond county line, near the northwest corner of section 34, township 4, range 4. It crops out there in the bed of the Locust branch of Shoal creek, and is said to be from fifteen to eighteen inches thick. It has a fine appearance, and is capped by eight feet of gray, slaty shales; then follow eighteen inches of black laminated slate, and two feet more of shaly slate, above which the limestone sets in. The distance from the limestone to the coal is at least eleven and a half feet, and this section closely corresponds to the one on Sugar creek, below the railroad bridge. The limestone is more exposed in the hillside farther east, but the strata dip in that direction. Near the middle line of the section, the black slates disappear underneath the bed of the creek, and a little farther on, the limestone forms the creek level. The coal could probably be worked profitably by stripping along its western outcrop.

On Shoal creek the limestone disappears underneath the water level, a little below the bridge, and the rocks which we find in the southwest quarter of section 1, and in sections 11, 12 and 13, overlie it, and belong to the upper sandstone formation. They dip perceptibly to the eastward, and consist of slaty and arenaceous shales and shaly sandstones, with calcareous or ferruginous concretions, and are at least fifteen feet thick, and capped by a calcareous sand rock, changing into an impure limestone, which varies in thickness from a few inches to two feet. On an eastward bend of the creek, in section 24, we observed the same limestone, with an eastern dip which is so strong that, at one end of the exposure, it is at the water's edge, while at the other end it is eight feet higher, and underlaid, as on Sugar creek, with eighteen inches of gray or blue shale, from eighteen inches to two feet of black slate, and below that by five feet of shaly, arenaceous strata. On the next lower bend to the westward, in the northeast quarter of section 26 (?), at an old mill-seat, the limestone also forms the bank of the creek, from the low-water mark upward. I noticed there also large blocks of a rotten, tumbling, impure limestone, which either immediately overlies the Shoal Creek limestone proper, forming a bed of transition to the upper strata, or else has slipped down a few feet from above. If it does not form the immediate continuation of the above named impure limestone, or calcareous sandstone, it is at least closely allied to it, and contains numerous fossils, among which are *Productus costatus* (?), *P. longispinus*, *P. Prattenianus*, *P. punctatus* (?), *Spirifer cameratus*, *Athyris subtilita*, and numerous *Bryozoa*, *Corals*, etc.

The Shoal Creek limestone rises west from there to the level of the high Shoal Creek prairie, and is exposed in the southeast quarter of section 22, township 3, range 4. It has also been found in the branches a mile farther northeast, in the north part of section 23 (?), where Mr. Potts dug for coal underneath the limestone, and came to the black slate and shales, and found six inches of coal. Farther south, the limestone also crops out in a ravine at the edge of the prairie, in the northeast quarter of section 34, and southeastward down along that ravine to Shoal creek, through section 35, and has been quarried extensively. At the highest outcrop in section 34, it is from eight to eight and a half feet thick, divided in thin layers of a few inches each, underlaid with black slates, and capped with about two feet of a firm, somewhat calcareous sandstone, very similar to the one which I had observed a few feet above the limestone on Shoal creek, below Jamestown, and perhaps an equivalent of the impure limestone described above. Lower down on the branch,

I observed, underneath the limestone, several feet of soft, shaly sandstone, perhaps with some slate intervening between the two. A few yards above the mouth of the branch, near the middle of the south line of section 35, township 3, range 5, the limestone is eight and a half feet thick, and from eight to sixteen and a half feet above the bed of the ravine.

At the bridge over Shoal creek, in section 2, township 2, range 4, the Shoal Creek limestone is still in the bank of the creek; but it is better exposed in the same position at the south side of the next lower bend. Above it we find about fifteen feet of slaty shales, arenaceous shales, and shaly sandstone, capped with a layer of calcareous sandstone, which changes to an impure limestone, with numerous fossils. At the Blue Mound, in the northwest quarter of section 3, water is obtained before reaching the limestone, and also in the prairie north of it; but between that point and Breese the shaly strata are struck which overlie the limestone, and sometimes the limestone itself.

At Breese, which is situated in the prairie, in the east half of the northwest quarter of section 22, township 2, range 4, the wells are mostly in the Quaternary deposits, but some have penetrated the lower strata. Thus, Mr. Marks, at a depth of sixteen feet, came upon shaly, arenaceous strata, and sunk through them to thirty feet below the surface, after which he bored to a depth of fifty-two feet. The boring passed through two very hard strata, at a depth of about forty-five feet, one of which was three or four feet thick, and between them there were several feet of soft clay. These two layers were undoubtedly the Shoal Creek limestone, and the clay filled one of its numerous crevices. West of Breese, no rock is struck in the prairie; but on the Carlyle road, east of Breese, the bank of Shoal creek is formed of limestone, in the northwest quarter of section 24. Below this point, no more outcrops of rock are found on Shoal creek, although the limestone formation extends considerably farther southward. The valley has a wide and rather wet bottom, which is heavily timbered, and much resembles the Okaw bottom. There are a few high escarpments on the creek, especially one southeast of Hanover, in the southwest quarter of section 11, township 1, range 4, below the bridge, on the east side, where the creek washes the foot of the high hills, composed of Quaternary deposits.

Between Breese and Hanover, Shoal Creek limestone has been found in several wells at no great depth, and water has mostly been found on reaching it; thus, in the east part of section 28, and in

the east part of section 33, township 2, range 4, also in the northeast quarter of section 4, township 1, range 4. In the northwest quarter of section 3, it was found only eighteen feet below the surface, five feet thick, and underlaid with at least five feet of black slaty rock. These are the most southern points where the limestone or any other rocks have been discovered in this district.

At Hanover, which is located in the southeast quarter of section 4, the water is obtained in quicksand. On a high hill farther northeast, near the center of section 34, township 2, range 4, which overlooks the prairie, and is covered with timber, a well has been dug, mainly through loose sand, to a depth of seventy feet, when shales appear to have been found. The alluvial deposits seem to be equally heavy in the hills, which extend from Shoal creek to the Okaw, north of Santa Fé prairie, east and southeast of Hanover. In some of these wells pieces of browned wood have been found at considerable depths, but no rocks of older formation.

Between Shoal creek and Beaver creek, in Beaver prairie, water is generally obtained in sand or gravel, at a depth of seldom over twenty-five feet; and on the higher hills in the prairie, in the same formation, at forty or fifty feet. Rocks have only been struck in three wells, as far as I could learn. They show, however, that the same formation continues under this prairie. At the western edge of the prairie, not far from an outcrop of the Shoal Creek limestone, on Shoal creek, this rock has been found in digging a well near the northwest corner of section 30 (?), township 3, range 3, while a couple of miles farther east, in the northwest corner of section 28, black slate was found in another, evidently the same which underlies this limestone. Farther north, in the southwest quarter of section 3 (?), township 3, range 3, on the east side of the prairie, limestone is also said to have been found thirty feet below the surface.

On Beaver creek not a single outcrop has been discovered. Pieces of a limestone, apparently of the Shoal creek bed, were, however, observed at various points at the foot of high alluvial banks, together with drift pebbles, east of the last named point, near the northwest corner of section 11, township 3, range 3, and on the east side of section 15. It would hardly be judicious to conclude that this rock was in place close by, although it is not unlikely, because it has been discovered still farther east. A quite similar bank occurs near the mouth of the creek, in the north part of section 1, township 1, range 4; and I have no doubt that the limestone passes through the hills near that point.

On a hill, near the Flat branch of Beaver creek, in the northwest quarter of section 6, township 3, range 2, limestone was struck in a well thirty-six feet below the surface, which appears to be the Shoal Creek limestone. It did not reach quite across the well, which must have struck a wide crevice in the rock. The latter was about four feet thick, and underneath it black slate was found by boring. On much lower ground, near the center of the section, the black slate was also found at a depth of twelve feet. A mile and a half farther east, near the southeast corner of section 5, on a hill, a well penetrated through forty feet of Quaternary deposits, and then fifteen feet in shales and slates. These may perhaps be higher than the limestone. Farther southwest, in the north part of section 15, over a prairie ridge, shaly arenaceous strata are said to be found, only a few feet under ground, which probably overlie the Shoal Creek limestone. At other points the alluvial deposits are very heavy, and in Carlyle prairie, between Beaver creek and the Okaw river, rocks are of very rare occurrence.

At Carlyle, the Shoal Creek limestone crops out again, near the north line of section 19, township 2, range 2, at the chain bridge, in the banks and bed of Okaw river. In the town, in the southwest quarter of section 18, a thin, hard areno-calcareous stratum, a highly calcareous sandstone, crops out in a ravine; at other points, a highly arenaceous limestone; and the same has been struck in various wells in the town. Between it and the Shoal Creek limestone, which is about seventeen feet lower down, slaty and arenaceous shales intervene. The Shoal Creek limestone is here reported to be eleven feet thick. The areno-calcareous stratum evidently corresponds to a similar one, which I have observed at several points near Shoal creek, as I have stated above. It is exceedingly full of fossils, especially *Bryozoa*, and also *Productus*, *Spirifer*, and many others. Underneath the Shoal Creek limestone black slate has been found here, and below that, arenaceous shales and sandstone, apparently of the slaty division, which appears to be thicker here than farther northwest, or at Nashville, in Washington county.

The Ohio and Mississippi Railroad Company bored, west of Carlyle, one hundred and eighty feet deep, but no trustworthy report could be obtained in relation to this undertaking. The great thickness of coal which was expected at a small depth, was of course not found; but it seems that the thin stratum of the slaty division was passed through.

The next outcrop south of Carlyle, is at Clabough's quarry, on the Okaw, two and a half miles from the last one, on the east side

of section 36, township 2, range 3. In the west bank of the river we find ten feet of irregularly stratified sandstone and arenaceous shales capped by some black slates; then, eighteen inches of gray shale, and above that, eight feet of Shoal Creek limestone. The latter is here mostly very hard, and is not as fine a building material as at most other points. No other rock is exposed above it. It rises considerably to the northwest, and is therefore exposed far up, along a ravine which comes from the hills at the quarry. A mile farther southwest, this limestone once more crops out in the bank of the Okaw river, and on the lower end of a branch in the southwest quarter of section 36, township 2, range 3. It is over eight feet thick, and here also rises to the westward, so that the underlying slates form the bed of the branch in the east part of section 35, above the quarry; and still higher up, in section 35 and on the east side of section 34, the underlying sandstones are exposed in its bed.

The river once more impinges against the hills on the west side, a short distance above the upper end of Santa Fé prairie, at the fish-trap, in the southwest quarter of section 1, township 1, range 3. The exposure is quite imperfect. We find on the bank and in the river, numerous large blocks of a limestone, which is apparently the Shoal creek stratum; also, calcareous sandstones, somewhat resembling the above described areno-calcareous stratum overlying the limestone; and blue slates, partly in place in a ravine. It seems to me as if the bed of the river was formed by the sandstone of the slaty division, which formed the bank at Claybough's quarry; that, higher, follow the slates; and still higher, the Shoal Creek limestone; and that these strata dip strongly to the eastward. The higher strata, above the limestone, are perhaps not in place in this hill. The summit of the hill has a heavy covering of alluvial deposits. Between this point and the Stone Coal Ford there are no more outcrops of rocks on the river.

North of Carlyle about two miles, the bed of Okaw river is said to consist of rocks, but I could not see them; and the banks were composed of alluvial deposits. A quarter of a mile farther east, near the northwest corner of section 8 (?), township 2, range 2, a well struck on solid rock, and water was obtained by boring through it. On a branch which empties near by, and at several points in section 5, large slabs of the areno-calcareous rock are reported to have been found, which appear to correspond to the stratum which is at Carlyle seventeen feet above the Shoal Creek limestone. I noticed the same rock in the bed of the branch in the middle of the

north half of section 5, where it has been quarried to some extent, and is overlaid with shaly sandstones. The latter crop out also higher up on this branch, in the south part of section 32, township 3, range 2, and extend through the east part of section 31, where they have also been quarried in a shallow prairie ravine. They contain some firm layers, but are mostly irregularly stratified and shaly. They have also been struck in a well near the center of section 36, township 3, range 3, on the high prairie.

There is only one more outcrop of rocks on the Okaw river, in this county, which is at McClellan's ford, in section 33, township 3, range 2. There the bed of the river is formed of sandstones, which probably form the continuation of the last-named rocks, and belong to the upper sandstone formation. A short distance west of the ford, at the foot of the hill, a thin seam of coal is said to have been exposed, but no trace of it is to be seen at present.

Keysport is situated on a very high bank of the river, not far from the north line of the county, in the northeast quarter of section 2, township 3, range 2; but no traces of any rocks are found in this vicinity, nor for several miles up and down the Okaw, or on the East fork in the northeastern part of the county, except at Casey's mill, in the northwest quarter of the northeast quarter of section 13, township 3, range 1. In the bank of the creek I here observed argillaceous and arenaceous shales, with intercalations of sandstone; and in the bed of the creek below them, black, highly calcareous and fossilliferous slates, at least a foot thick. Besides, I noticed pieces of ordinary black laminated slates, and a more purely calcareous rock, which probably come from another point of the same stratum. Underneath the calcareous slate, in the bed of the creek, twelve inches of coal are said to have been found in digging. These strata evidently belong to the upper sandstone formation, which is more extensively exposed a little farther up the creek, in Marion county.

No rocks have been discovered in Clinton county east of the Okaw, from the East fork to Crooked creek; but on the latter we find outcrops of the upper sandstones. On the low hills on the south side of Crooked creek, in Washington county, these sandstones were found on the west side of section 26, township 1, range 2, and at various points thence eastward.

In the report of Washington county, I have also referred to a reported outcrop of rocks, perhaps of the Shoal Creek limestone, farther west in the bed of Crooked creek, in the southeast quarter of section 21, and to the tumbling limestones below this point; also,

to the outcrop of areno-calcareous rocks at Joliff's mill, on Crooked creek, in the northeast quarter of section 25, or the southeast quarter of section 24, township 1, range 2. There, I found in the bank of Crooked creek, from two to two and a half feet of a finely-grained, grayish-blue calcareous sandstone, or mudstone, of not quite uniform composition, and with a brown surface. It contains numerous fossils, especially *Productus*, *Spirifer*, *Myalina*, etc., and is underlaid with a few feet of arenaceous shales. I expressed the opinion that it probably corresponded to a similar stratum which had been found in the pit at Nashville, sixty-two feet above the Shoal Creek limestone. It resembles, also, in many respects, the areno-calcareous stratum observed at Carlyle, and on Shoal creek, seventeen feet above the Shoal Creek limestone; and all of them may, perhaps, be one and the same, although I am by no means positive in regard to this point. Farther east, apparently higher sandstones and shales had been observed on Grand-point creek, a mile above its mouth, in section 29, township 1, range 1, and on Crooked creek, in Clinton county, a little above the mouth of Grand-point creek, in the southwest quarter of section 19, township 1, range 1, similar strata crop out. Thence up Crooked creek we find no more rocks exposed until we approach the Marion county line, near Central City.

At Joliff's mill, at the bridge over Crooked creek, on the road from Central City to Carlyle (which should not be confounded with another old mill of the same name, six miles lower down Crooked creek, in Washington county, which I have mentioned above), in the northwest quarter of section 1, township 1, range 1, I observed another stratum of calcareous sandstone, very similar to that already described. It is thirty inches thick where it is best developed, and here dips beneath the water level to the westward, but is seen again in the bank a little farther west. It contains the same fossils as at the other localities.

In digging at the bridge, a thin seam of coal, about a foot in thickness, was found about twelve feet below this calcareous sandstone. It is the same which is exposed at the ford of the creek, north of Central City. Above the sandstone, at the mill, we noticed a considerable thickness of shales, which are partly arenaceous, and contain concretions of carbonate of iron. Such shales are also exposed in the bank of the creek, near the west line of this section 1, township 1, range 1, which is the last outcrop to the westward for a considerable distance; but I rather think that they underlie the calcareous sandstone, and are not the same as at the bridge. Up the creek, toward the Marion county line, the same strata continue.

The calcareous sandstone is frequently found, either in place or tumbling, in the upper part of the bank; in the lower part the underlying shales crop out, which, at some points, also contain calcareous portions, full of fossils. Near Central City, beyond the county line, we find some ledges of sandstone interstratified with the higher shales, and at the ford above the railroad bridge north of Central City, the coal is ten or twelve inches thick, and the next lower strata consist of three or four feet of shales, with some concretions of iron ore, and then three feet of slates, the lower part of which are shaly and somewhat arenaceous, and the upper dark-colored, bituminous, calcareous, and full of fossils similar to those in the higher arenaceous stratum. A complete section of the strata on Crooked creek, near the Marion county line, would therefore be about the following, in descending order:

1. Shales, partly arenaceous, with, in places, some layers of sandstone, and much kidney ore, at least 35 feet thick.
2. An areno-calcareous layer, with numerous fossils, generally a hard calcareous sandstone, which varies between 1½ and 2½ feet in thickness.
3. A seam of coal, 10 or 12 inches thick.
4. Shales, partly arenaceous, with kidney ore. At some points these change not far below the coal into dark-colored calcareous slates, with fossils.

At first it would seem as if the areno-calcareous stratum at the Joliff's mill, near Central City, was the same as the one at the other Joliff's mill, six miles farther southwest; but, upon mature deliberation, I came to the conclusion that they are probably different; that the latter is much lower in the upper sandstone series, to which they both belong, and that the coal-seam underneath the upper one, corresponds perhaps to the one on the east side of Washington county, high up in the upper sandstone formation; and also to the one on the east fork of Okaw river, at Casey's mill. The calcareous rocks which are connected with these coal-seams, vary considerably in appearance, but they may nevertheless be of common origin and contemporaneously formed. The difference between them is not greater than between different outcrops of evidently the same formation, higher up on the east fork, and at other points in Marion county, which will be described in the report of that county; and is due to the different form in which a small amount of lime has been deposited while an arenaceous and shaly formation was being formed; so that we find it now either as a thin ledge of limestone between shales and sandstones, or as a calcareous sandstone, or as a calcareous mudstone, passing into a calcareous slate or slaty limestone, or as a sort of pudding-stone or concretionary limestone.

Economical Geology.

Coal.—From the foregoing remarks, it appears that the upper part of the Coal Measures occupy the whole of Clinton county, and that the higher strata of this formation gradually succeeded above the lower ones to the eastward. In these upper Coal Measures we find principally two coal seams, which are of some importance, although they are thin. One is in the highest part of the formation, in the upper sandstones; the other one at the base of the slaty divisions, below the Shoal Creek limestone. The first one of these has, up to this time, only been exposed at two points in this county—at Joliff's mill, on Crooked creek, near Central City, and at Casey's mill, on the east fork of Okaw river—both points being situated close to the east line of the county. Being hardly more than ten or twelve inches thick, it can be worked only by stripping along its outcropping edges, and the slightly broken configuration of the surface is not favorable to this kind of exploration. Still it might be of some local importance at a few points, if it was followed up. The other seam has been found from ten to twenty (and in Washington county at least more—at some points as much as fifty) feet below the Shoal Creek limestone, and appears to vary between ten and eighteen inches in thickness. As far as I have been able to ascertain, it has been discovered wherever the strata have been exposed or penetrated at the proper level in this county. It has been found in a shaft at Trenton, at a depth of thirty-two feet below the level of the prairie, and consisted there of two seams of five and twelve inches of coal, with seven inches of shales between them. It has also been observed at several other points in that vicinity. Then it was noticed a short distance north of the county line, on Locust branch of Shoal creek, not far from Jamestown, from fifteen to eighteen inches thick, and at the Stone Coal Ford of Okaw river, on the Washington county line, ten or twelve inches thick. Beyond the county line it can be traced southeastward through Washington county, and probably farther. In Madison county I observed the same coal seam in the coal-pit at Highland, where it is eighteen inches thick, seventeen feet below the Shoal Creek limestone, and seventy-five feet below the surface; and it is the same seam which has been worked to a considerable extent one and a half miles northeast of Highland, where it is also eighteen inches thick, and crops out on a branch.

It seems also more than probable that this is the coal seam which has been found at Central City, just east of the east line of Clinton county, at a depth of one hundred and eighty feet. This seam, therefore, appears to extend nearly all over the county, and undoubtedly might easily be denuded on many a hillside in the eastern half of the county. At Highland it has been profitably worked to a considerable extent, by drifting, and there is no good reason why it might not be worked in the same manner, or by stripping its outcrops, at many points in this county. It may yet prove of considerable local importance. Wherever the Shoal Creek limestone ranges, its position might easily be ascertained by boring underneath that rock.

The thin seams of coal in the lower sandstone formation do not crop out in this county, and are most probably too thin to be of any advantage at the depth at which they occur.

The most important geological question for Clinton county, and one which is decisive in relation to her prospects of future development as a manurfacturing region, is, whether the stone coal of the lower Coal Measures extends under her surface—the coal to which the adjoining county of St. Clair owes a large share of its vast wealth, which, great as it is, has hardly begun to be developed, and is capable of any conceivable expansion. This is the problem upon the solution of which turns, in a great measure, not only the prospective richness of this county, but also of some of the adjoining counties to the south, north and east.

We know that the Belleville coal of the lower Coal Measures is nowhere near the surface; but it undoubtedly extends at least under the western part of the county, and I can see no good reason to suppose that it does not extend under the whole. Still, we have no positive proof which would substantiate this assertion. At Mascoutah, in St. Clair county, not quite six miles west of the Clinton line, and near its south end, a mine is worked on this coal-bed, at a depth of only one hundred and thirty-two feet. The coal would undoubtedly lie considerably deeper in Clinton county, east of Mascoutah; but I see no reason why it should thin out in that small distance, after having found it extending many miles with remarkable uniformity. At Summerfield, on the Ohio and Mississippi Railroad, in St. Clair county, only two and a half miles west of the Clinton line, the coal is also worked in a mine at a depth of two hundred and seventy feet. It is there only from four to four and a half feet thick, and the top coal of the bed is not as much developed as at other points, but this may be due to local causes, and

we must not necessarily conclude that the coal was generally thinning out in this section, although it may be so. We can hardly doubt that the coal extends beyond Summerfield into Clinton county; but whether it extends all through the county, and with undiminished thickness, or whether it thins out, cannot be ascertained, except by digging or boring. The development of the main coal in the lower Coal Measures is so very uniform over the extensive district of many miles in length, and embracing several counties over which I have thus far been able to follow it up, that I can not believe that it should not also be extensively developed in breadth, and continue far into districts where it is now hidden by overlying strata, as it would be in this county.

Taking, then, for granted that the Belleville coal extends through Clinton county, the question arises as to its depth. It undoubtedly increases to the eastward, where the higher divisions of the Coal Measures prevail; but it is impossible to tell whether it probably follows the same undulations as the Shoal Creek limestone, or not, and whether it has not undulations of its own, which do not extend into the higher strata.

The coal seams have been formed in marshes, or quite shallow water, while the strata above and below them, of the same formation, have been deposited in a more or less deep sea. The consequent frequent changes of the water level, during the Coal Measure period, have caused a greater irregularity in the thickness of the deposits in contemporaneous and adjoining portions of the same measures than in other formations; and we perceive their regularity only by considering them collectively and as a whole, while from a less comprehensive point of view we might fail to recognize it.

We are in possession of a few data from which we may judge of the depth at which the coal may probably be found in this county. At Nashville, in Washington county, the depth of the coal under the Shoal Creek limestone is probably about three hundred and sixty feet. The strata in the pit at Summerfield, in St. Clair county, are lower than this limestone; but I think that if it reached thus far west, it would be hardly more than three hundred feet above the coal. At Centralia, in Marion county, if we may assume the foregoing statement as a fair basis, I placed the depth of the Shoal Creek limestone at two hundred and twelve feet, and that of the coal at six hundred and forty feet, which would give their distance four hundred and twenty-eight feet, which is rather more than I am willing to accept without expressing a doubt as to its correctness. Taking these data as a basis for further calculations, I would give

the following numbers as the probable depth of the coal at different points, allowing a large margin for irregularities of the formation, and for other uncertainties connected with the fundamental data of the calculation: In the extreme southwest of the county, near and south of Baden, two to three hundred feet; at Trenton and vicinity, and farther east, about three hundred feet; near Hanover and in Santa Fé prairie, from three to four hundred feet; on the Okaw, near Ogle, near four hundred feet; about the same or a little more toward Keysport, and still more east from there; finally, toward Centralia, six hundred and forty feet, which should, however, be accepted with caution.

Minerals.—Of minerals we only find concretions of impure carbonate of iron, kidney ore, in the shales of the Coal Measures. These, although very extensively distributed, are found nowhere accumulated in sufficient quantity to be valuable as an iron ore.

Building Materials.—As far as the Shoal Creek limestone extends, in the northwest and central parts of the county, it furnishes a superior building stone, and, when burnt, a good, but not very white lime. At a few other points some sandstone is quarried, and on Crooked creek, the areno-calcareous layers. In the southwestern and northeastern parts of the county, rock are not easily accessible, but good brick can be manufactured anywhere. Timber is also plenty for building and other purposes.

Agriculture.—In the chapter on the surface configuration of the county, I have already described the principal features of the county which combine to determine its agricultural value, and I need not repeat these remarks. The general character of the soil is still the same farther south, over the upper Coal Measures, which have been described in the report on Perry county. The prairies have, however, gradually assumed a character somewhat different from what it was farther south. This is due partly to their greater extent, and the greater flatness of the country, and, consequently, less complete drainage, and partly to a difference in the sub-soil. The soil is still similar to that of the prairies farther south, consisting mainly of the same impalpable, fine, arenaceous material; and often it is even richer in vegetable mould, and is therefore of a darker color. Its thickness is quite variable—from a few inches to two and a half feet. The sub-soil differs considerably at different points; frequently, however, it consists of a heavy deposit of a hard-pan, several feet in thickness. This hard-pan is a leading feature over a large area in and beyond Clinton county, and is similar to the sub-soil of the post oak flats, inasmuch as it is also an exceedingly finely

comminuted arenaceous material, a whitish siliceous loam, which, when it is dry, is firmly and densely packed, and when it is wet shows little cohesion. In this sub-soil we find a large amount of ferruginous nodules and small lumps of hydrous oxyd of iron. While the sub-soil is full of these dark-brown nodules, it is still whitish, and entirely free from the color produced by oxydized iron. This circumstance indicates the cause of its defective condition, in relation to which I can only repeat what has been said of the white soil of the post oak flats. In the wet season this sub-soil is saturated with water, and then has little cohesion, and is extremely soft, so that wheels will sink in it as in quicksand. Then, vegetable substances which it contains ferment, because the air is excluded, and thus act as a deoxydizing agent upon the peroxyd of iron of the nodules and the soil, and form vegetable acids which combine with the protoxyd of iron thus created, instead of decaying and thus forming fertilizing compounds, as they would if the air could gain proper access. The dryness of the summer remedies these defects, but the sub-soil remains closely packed and very imporfectly accessible to the air. The iron has again been precipitated and aggregated to the nodules, and contributes to render the sub-soil so hard and intractable as to make a hard-pan of it. The influence of this sub-soil is little felt where the upper soil is deep and rich; but where it lies shallow, some crops suffer severely, and it requires much labor and good tillage to counteract its influences to a certain degree. How hard it gets may be judged from the fact that, where this hard-pan prevails, the use of chisel-shaped augurs is found most profitable for drilling holes in which to set fence posts, while the spade and pick are found to work very slowly. Where the soil becomes shallow, and the hard-pan reaches the surface, there we find the so-called "scalds," or barren spots, in the fields. Everything which tends to loosen the sub-soil, will improve it and make it fertile, because it is not necessarily a poor soil and defective in the ingredients which are essential to the healthful development of plants. Sub-soiling alone will not help much, unless deep stirring is continually repeated, because the soil would be packed close by every heavy shower. The most effectual remedy would probably consist in underdraining, whereby the air would gain continual access to the soil. Whether the application of lime would prove beneficial, I cannot tell beforehand; it ought, however, to be tested. Generally, lime renders a soil more mellow; but it also accelerates the decomposition of all organic substances contained in it; and whether this would not outweigh the advantages to this soil,

naturally not rich in humus, can be determined by experiment only.

At other points, we find in the sub-soil, instead of the ferruginous nodules, calcareous concretions of whitish color. The color of this sub-soil is still white, but I think it is preferable to the other, and can not be without improving influences upon the soil. It would at least neutralize any acid tendency in it, and make it mellower.

Clinton county is fast settling up, and the facility for marketing its produce, by the Ohio and Mississippi Railroad, which runs from east to west thirty miles through the county, dividing it into two nearly equal parts, or by the Illinois Central Railroad, which runs near its east side, beyond the county line, increase the value of its lands beyond that of many other equally productive districts.

CHAPTER VII.

MARION COUNTY.

BY HENRY ENGELMANN.

Marion county is bounded on the north by Fayette county, on the east by Clay and Wayne counties, on the south by Jefferson county, and on the west by Clinton and Fayette. It embraces townships 1, 2, 3, and 4 north of the base line, in ranges 1, 2, 3 and 4 east of the third principal meridian—sixteen full townships, or five hundred and seventy-six square miles, about equally divided into prairie and timber land.

Geographically the county is equidistant from the Mississippi and Wabash rivers, and the water-shed between these, and between the Kaskaskia and Little Wabash rivers, passes through it.

Surface Configuration, Streams, Etc.—The northwestern part of the county is watered by the upper course of the east fork of the Kaskaskia river, and by its tributary, the north fork, and their branches. In the southwestern part of the county we have the upper course of Crooked creek, another tributary of the Kaskaskia river, and its principal branch, Raccoon creek. The eastern part of the county is drained by the upper course of the Skillet fork of Little Wabash and its branches; while in the extreme northeastern corner head some branches of the Little Wabash itself. There is no lack of water in the county for all ordinary purposes. Away from the creeks and their branches, water can everywhere be obtained in wells at a moderate depth.

The principal creeks, especially the Skillet Fork, have along a portion of their course a considerable breadth of heavily-timbered bottom lands, and all the water-courses, except at their very heads, are fringed with timbered uplands. Where the channel of the creek lies very deep below the level of the surrounding country, these

timbered lands are somewhat broken, passing into rolling barrens and post oak flats, and where the creeks have shallow valleys, they are rolling or flat.

The central portion of the ridges, and the flat and gently undulating stretches of upland, at some distance from the principal water-courses, are occupied by prairies, which ramify between all the creeks, and comprises about one-half of the whole area of the county. The prairies in Marion county are all either on the same level, or higher than the surrounding timbered lands; while some of them, especially on the main water-shed west of the tributaries of Skillet Fork, present a considerably elevated surface of hills and prairie ridges.

The sub-soil, in part at least, of the prairies of Marion county, is the same white, finely comminuted, arenaceous loam, with ferruginous nodules or concretions, which, as a hard-pan of considerable thickness, has been observed at many points in Clinton county, and has been described in the report on that county. It forms a prominent feature in the prairies of this and adjoining counties, and exercises a dominant influence upon the agricultural value of the lands, according to the greater or less depth at which it is found. Where it lies shallow, and comes close to the surface, it produces the so-called "scalds;" where it lies deep beyond the reach of the roots, it exercises no direct influence, except, perhaps, in rendering the land more subject to severe drought than where the sub-strata are more more open and permeable to moisture.

The timber in Marion county is the same as in the adjoining counties—such as has been described in the report of Clinton and Perry counties. The post oak flats and barrens are still developed to a considerable extent, and with their characteristic growth. The barrens are most perfectly developed in the vicinity of the Skillet Fork, where the grasses are being gradually superseded by a growth of timber; and we find on them principally post oak, and small black and white oak, together with hazel and sumach. The more broken hills are covered with similar but heavier timber; while the bottom timber is also the same as in Clinton county.

Geological Formations.

The rocks which crop out in Marion county all belong to the upper Coal Measures—to the division which has been designated in the preceding chapters as the upper sandstone formation, and overlies the Shoal Creek limestone. It has been observed in the eastern

part of Clinton county, and in the northeastern part of Washington county, and described in the report on these counties, with the associated strata; but in Marion county we seem to have only this one sub-division, and the geology of the county therefore presents a great degree of sameness. This formation corresponds, in this county, to the description of it given in Washington county, only we find still higher strata of it, so that it is somewhat thicker. The calcareous matter appears at some points in the shape of strongly cemented, very compact, calcareous sandstones; at others, as a calcareous mudstone or calcareous slate, which is generally full of fossils; and at others still, as an areno-calcareous puddingstone, or as purer layers of limestone. At a few points this limestone attains so considerable a thickness that one is tempted to consider it as a distinct sub-division of the Coal Measures; but it appears to vary within short distances, and to be merely a local accumulation of calcareous matter. I have at several points seen this limestone thin out within a distance of a few feet. At one point it formed a solid layer; at the next, only single blocks, like concretions or thin slabs; or it changed into a calcareous slate, and close by was lost entirely.

This formation contains at least one coal seam in this county, which has been discovered at many points in various and distinct localities, and appears to be developed rather uniformly and continuously. At some points it attains a sufficient thickness to be profitably worked for supplying at least the local demand for coal. Other outcrops of coal in the county may represent only local deposits, and appear to be of little importance.

The strata in Marion county do not conform to the general eastern and northeastern dip, which was observed in Clinton and Washington and the adjoining counties; but they exhibit local undulations, such as we have already observed in Clinton county, with the Shoal Creek limestone. They appear to rise gently eastward toward the main dividing ridge, east of the center of the county, following the general direction of the undulation of the surface; and then they continue horizontal, or dip again slightly to the eastward.

I will now describe the outcrops as they appear in the different parts of the county:

Beginning in the northwest corner of Marion county, we find no rocks exposed on Flat creek, which runs close along the Fayette county line, nor at any point along the North Fork, along its whole course in this county, in township 4, range 1 and 2, nor on the smaller branches. In the shallow wells in the prairies, on both sides

of the North Fork, no rocks have been struck; but there can be no reasonable doubt that the sandstone formation underlies this whole district.

At Patoka, near the center of the south line of section 28, a well was sunk at the railroad station, deeper than the wells ordinarily are, in order to obtain a large amount of water for a tank. I am informed that it passed through:

1. Soil, clay, etc ..... 15 feet
2. A kind of hard pan ..... 15 "
3. Blue clay, with sand and pebbles, and with pieces of coal, brown wood, etc ..... 30 "
4. Blocks of limestone, containing some fossils ..... 2 "

By the description which I received of this layer, I was not satisfied whether it was a concretionary limestone, and formed a stratum with open joints, and corresponds to a stratum of limestone which I observed farther southeast and east, on the East Fork, below the coal seam, or whether it consisted merely of tumbling masses of this limestone. Below it they bored thirty feet, through a soft material, apparently shales.

On the east fork of the Okaw, however, rocky outcrops are numerous. In the report on Clinton county, I have mentioned the exposure at Casey's mill, not quite half a mile west of the county line—the first one on the creek from its mouth. It consisted of argillaceous and arenaceous shales, with intercalations of sandstones, and below them of black, highly calcareous and fossiliferous slates, at least one foot in thickness, below which, underneath the water-level, twelve inches of coal have been discovered. These strata form part of the upper sandstone formation of the Clinton county section. I suggested then that this coal and calcareous slaty rock probably corresponded to a similar formation in the western part of Marion county, on the East Fork and Crooked creek.

Turning east up the creek, we find small outcrops of the shales and some sandstone, which is mostly hard and calcareous, near the line of section 17, and again a quarter of a mile below the railroad bridge, in the south part of section 17, township 3, range 1. Arenaceous, shaly strata are also exposed at a higher level on a ravine in the east part of section 19, and have been struck in wells in the timbered hills near the edge of the prairie about there; and sandstones have been quarried occasionally three-quarters of a mile south of the creek, on the west side of the railroad, in section 20, where they are partly soft and yellowish, partly hard, bluish and calcareous.

Shales were observed in the bed of the East Fork, east of the railroad, near the mouth of Davison's creek, which is in the southwest quarter of section 16; and they are also exposed in the banks of the latter, at various points, in the north part of section 21, in section 22, and apparently farther up, while both kinds of sandstone overlie the shales, and were noticed tumbling in large masses in the branch at points where the hills rise steep in the sections just named. Not a trace of the coal has been observed on this creek.

In the northwest quarter of section 15, in the south part of section 10, and in the west part of section 11, sandstones and shales are variously exposed in the banks of the East Fork, and at some points higher up in the hills. In the southwest quarter of section 11, I found heavy slabs of a highly fossiliferous, blackish, slaty, calcareous rock, similar to that of Casey's mill, which must have tumbled down from the higher part of the slopes; and in the center of section 10, near the edge of the prairie, Mr. Hawkins is reported to have struck a seam of coal in his well, probably the same as at Casey's mill. The sandstones have also been struck in varicus wells at the edge of the prairie north of the East Fork, in sections 10, 11 and 1, township 3, range 1, but not farther east or west.

On Jim creek, close to its junction with the East Fork, not far from the center of section 12, township 3, range 1, the bank consists, to a height of about three feet, of argillaceous, slaty shales, with concretions of kidney-ore; then eighteen inches of coal, capped with argillaceous and slightly arenaceous shales. Next underneath the coal, I observed some calcareous rock, which is here quite subordinate and only concretionary, so that it can hardly be said to form a layer; but it resembles and takes the place of the heavy stratum of concretionary limestone which is found some miles farther up the East Fork. I also noticed small slabs of the highly fossiliferous calcareous slaty rock mentioned above, which is here again above the coal, but little developed; while a few rods from here, on the East Fork, just below the mouth of Jim creek, it protrudes and has tumbled out of the bank in heavy masses. By digging in the bank there the coal has also been discovered eighteen inches thick. On the East Fork, a short distance above the mouth of Jim creek, the shales, with the kidney-ore and calcareous concretions, reach to a height of ten feet. Farther up the creek we find, at several points, alternations of shales and sandstones, as in the north part of section 12, in the southeast quarter of section 1, township 3, range 1, and in the south part of section 6, township 3, range 2. The sandstones are of variable quality, partly purely arenaceous, partly of the calcareous, hard, bluish and

splintery variety, partly smooth and easily dressed, and partly hard and ripple-marked. The same strata crop out also farther south on Jim creek, in section 7.

For some distance, then, we find no exposures on the East Fork; but on a branch south of it, not far from the middle of the south line of section 32, township 4, range 2, the coal is said to have been exposed a number of years ago. Then shales, apparently the lower ones, crop out on the main creek, near the middle of the north line of section 33. In the northeast corner of section 33, at the foot of the hills, the coal has also been found in place, capped by nine inches of the black, highly fossiliferous, slaty, calcareous rock, which we have before found at various points. Mr. Smith, in digging a well at a higher level on the slope close by, in the southeast corner of section 28, struck the overlying sandstone; while at his house on the brow of the hill, not far off, he passed through fifty-two feet of Quaternary deposits. A short distance farther southeast, just across the section line, in section 34, on the south bank of the creek, a more complete exposure was noticed. It consists, underneath the soil, of—

1. Gray slaty shales.....2 feet
2. Bluish slate.....1 foot 6 inches
3. Coal.....1 " 6 inches
4. Gray argillaceous shales.....4 feet
5. Siliceous or sandy limestone.....6 inches to 2 "
6. Gray argillaceous shales.....6 "

The sandy limestone (No. 5) has a concretionary appearance, and is, notwithstanding its great hardness, much cracked and decomposed by atmospheric influences. I had seen a similar rock, less prominently developed, near the mouth of Jim creek. It contains fossils, some of which were also observed in the areno-calcareous strata of Crooked creek, which it resembles in some respects, and of which it seems to form the continuation.

The sandstone struck in the well is evidently higher than No. 1, or rather forms an intercalation in the shales which form the continuation of No. 1. The coal has also been struck in digging a well a short distance east of the last outcrop on the upland, in the northwest quarter of section 34, at a depth of thirty-two feet.

Continuing up East Fork, we find more of the shales and of the calcareous rock from underneath the coal, in the northwest quarter of section 34, and in the southwest quarter of section 27, township 4, range 2. In the latter quarter-section the coal has been dug up near the creek. On Mr. Wilden's land, close to the center of section 27, it has also been wrought in the lower part of the bank, and

is said to have been eighteen inches thick; and it has again been discovered on a small branch south of the East Fork, near the middle of the south line of section 26, capped by the calcareous, slaty rocks.

Then the coal has been found on the East Fork, in the northwest quarter of section 25, township 4, range 2, at a former mill-seat, known as Strickler's old mill. It has been dug there out of the bed of the creek, and is said to have been sixteen inches thick; but the only traces of the old digging, which were to be seen at the time of my visit, were fragments of coal and slate, and the fossiliferous and calcareous slate. From this point the strata appear to rise still more toward the dividing ridge, because, south and southeast from here, the coal has been discovered near the edge of the high prairie, not far from the head branches of the East Fork, while on the main creek no more traces of it have been observed. The hills along it are rather high and broken, and evidently contain sandstones; but exposures are quite rare, and consist principally of shaly sandstones and shales especially in section 19, township 4, range 3, while farther up, in the north part of township 4, range 3, the banks of the creek consist of clay and sand, and the slopes present hardly any exposures.

On ravines running into the East Fork, northwest of Alma, near the edge of the prairie, I noticed numerous small outcrops of shaly and thinly-stratified sandstones; below them, gray shaly strata, with concretions of carbonate of iron; and finally again, the coal, some distance down the branch, in the southeast quarter of section 1, township 3, range 2, at Martin's old diggings. It forms the bed of the creek, and was not exposed, but is said to be at least fifteen inches thick. I found the fragments of black laminated slate, and of the fossiliferous, calcareous slate, but the limestone seems not to have been prominently developed at this point.

Alma is situated on the high prairie, in the northwest quarter of section 7, township 3, range 3. In a high part of the town, Mr. Martin struck sandstone at a depth of only ten feet, and some coal at thirty-eight feet. On lower ground, farther south, near the railroad, this coal has been found shallower; but still farther, in the southwest quarter of section 7, where the railroad company dug a well for making a tank, only slaty shales appear to have been penetrated, which would seem to underlie this coal. In boring deeper, coal is said to have been discovered there, at a depth of about one hundred and thirty feet, and of considerable thickness. Coal may have been found at that depth. Perhaps it was the same as at Martin's diggings, which is the East Fork seam, in which case the

one in Mr. Martin's well is a thin, higher seam; or else it may be a lower stratum; but it is certainly quite thin—too thin to be mined at that depth.

One and a half miles north of Alma, the East Fork coal is again exposed on another prong of the creek, near Mr. B. Howell's, in the southwest quarter of section 31, township 4, range 3. The coal is also dug from the bed of the creek, and I did not find it exposed. It is from fourteen to eighteen inches thick, and of very fair quality; contains little sulphur, and is preferred by blacksmiths, although it is soft and laminated, and the cuboidal pieces in which it breaks generally present the same dull appearance which is common to the other outcrops of this coal seam. It has also been dug a little higher up the branch, but is said not to be so good there. Near by I noticed shales and shaly sandstones, and, at another point, black laminated slates, which form the roof of the coal, but only traces of the calcareous, fossiliferous slate. I observed, however, numerous large masses of a very impure limestone, which seems to be intercalated in the shales, and to overlie the coal, such as I found in township 3, range 4, at Hensley's coal-bank, northeast of Omega; and this outcrop is interesting, because it shows the connection between these so very different outcrops of the same coal seam.

On another branch of the East Fork, a mile farther northeast, also near the edge of the high prairie, the coal is exposed again at the old Howell place, in the southwest quarter of section 29, township 4, range 3. At the head of this branch I noticed sandstone and shaly, arenaceous strata; then shales, and, finally, the coal, which is here from fifteen to seventeen inches thick, and rests on clay shales, and is capped by the black laminated slate; and at another point, only a few yards distant, by a shaly, rotten material, above which follow some ledges of the blue calcareous, highly fossiliferous slate, which has been mentioned so often. Near by I also noticed fragments of the impure limestone, with the shales above the slates and coal.

The same coal seam has been found at several points on a more eastern prong of the same branch, especially at Mr. Pruet's, in the southeast quarter of section 29, where the coal has been dug in the bed of the branch, and is reported as having been ten inches thick, of good quality. The black slate and traces of the calcareous slate were found there also. Lower down the branch, I observed some hard, strongly cemented calcareous sand-rock and soft sandstones. A good quarry might be opened near the center of this section.

Shales and some sandstones are struck in wells at the edge of the prairie in the south part of section 21.

At Kinmundy, in the southeast quarter of section 22, township 4, range 3, sandstone is struck in all the wells from six to twelve feet below the surface, and they have to be dug from fifteen to thirty feet deep. The sandstones crop out at numerous points down the branch, in the north half of section 22, and are quarried in several places for building purposes. They are mostly soft, partly massive, some of them are shaly, and some of them are hard and slightly calcareous. Towards the lower end of the branch, shales form its bank at several points, making the bottoms wet, and causing pools of stagnant water. All these rocks appear to be from a lower level than the coal seam.

Further up the East Fork I did not observe any more rocks in its banks in this county, except at a single point in the middle of the prairie, in the northwest corner of the southwest quarter of section 6, township 4, range 4, southwest of Farina Station. There, some of the calcareous sandstone crops out in the banks of the creek, and near by I noticed, together with drift boulders, a large slab of a limestone, which resembles the limestone above our coal seam, and may indicate its presence in the adjoining hills.

More of the sandstones, limestone and coal were found on the east side of the prairie, on the waters of the Skillet Fork, which will be described below.

In my report on Clinton county, I have already discussed the formations on Crooked creek, near the county line and Central City, and have shown that they present the following succession of strata in descending order:

1. Shales partly arenaceous, with concretions of carbonate of iron, and with occasional layers of sandstone, at least thirty-five feet.
2. In their lower portion these shales contain an areno-calcareous layer, generally a hard calcareous sandstone, from one and a half to two and a half feet in thickness, with numerous fossils, *Productus*, *Myalina*, *Nautilus*, with some *Gasteropods*, *Bryozoa*, etc.
3. A seam of coal ten or twelve inches thick.
4. Shales partly arenaceous, with some carbonate of iron, the kidney ore. At some points these contain, not far below the coal, some dark-colored calcareous and arenaceous slates, with some fossils.

This section was obtained by examining the strata from an old mill-seat, half a mile west of the Clinton county line, on Crooked creek, to Central City, half a mile east of the county line. It bears some little resemblance to the one obtained from the examination of the strata on the east fork of Kaskaskia river, while we find that the strata some miles farther east correspond decidedly to those accompanying the coal seam near the East Fork. Still, I am not

satisfied that these strata near Central City are really lower in the series than the others; they may be the same with only a local variation in their development. The calcareous strata which we find with the coal seam, vary considerably, and the difference between those near Central City and the East Fork, is hardly greater than that between different outcrops of these strata on the East Fork, and at other points in the county. The observation of other coal seams teaches us that the rocks accompanying the same coal-bed, even at neighboring points, often vary to such a degree that one might be tempted to conclude that there were two or more distinct coal-beds, if their identity was not plainly evident to the dullest observer by other marks.

The calcareous sandstone, No. 2 of the above section, crops out in the bank of Crooked creek, near the county line. Farther up the creek, in the northwest quarter of section 6, township 1, range 1, the shales, No. 1, are variously exposed, and they also underlie Central City, on the southeast quarter of section 6. The sandstones interstratified with them are found tumbling near the creek, and have been quarried in the low uplands northwest and southeast of Central City, in the northwest quarter of section 6, and in the northwest quarter of section 8. They are partly soft, partly hard, bluish, and somewhat calcareous. In some places they are ripple-marked. Their aggregate thickness at these points is only a few feet.

At the ford north of Central City, just above the railroad bridge, the bed of the creek consists of fossiliferous calcareous shales; then follow three or four feet of argillaceous shales, and twelve inches of coal; and higher up the coal is also overlaid by shales. Arenoargillaceous slaty shales form the bank of the creek, near the northeastern edge of the town, in the northwest quarter of section 5, and on a branch farther north, in the west part of section 32, township 2, range 1.

Above the mouth of Raccoon creek, in the west part of section 4, a bluff on Crooked creek, about twenty feet high, consists of shales, with seams of sandstones. Farther on, still in section 4, near Meyers' old mill, the bank of Crooked creek presents fifteen feet of alternations of thin layers of shales, with equally thin layers of sandstone, each from one and a half to six inches in thickness; the uppermost layers of the sandstone thickening irregularly. Above these I observed large blocks of a calcareous slaty rock, or a highly fossiliferous calcareous mudstone, which apparently takes the place of one of the calcareous strata in the above section, of No. 2 or of No. 4, and has slipped a few feet down from its original position

It reminds me strongly of the calcareous fossiliferous slate of the East Fork. Half a mile farther up, on the east side of section 4, and then also in section 3, the rocks are laid bare at several points on the south bank of the creek. They are more or less arnaceous, and calcareous mudstones, some three feet thick, with numerous traces of fossils.

South of this point, on Raccoon creek, the same strata are exposed. The first outcrop above its junction with Crooked creek, in the northeast quarter of section 8, consists of arenaceous shaly layers. Then, in the northwest quarter of section 9, at a bend on the north side of the creek, and a few feet above the water level, the calcareous mudstone, or slaty limestone, is again exposed, at least eighteen to twenty-four inches thick, with numerous *Productus*, *Bellerophon*, and other fossils. Farther on, toward the center of section 9, it still holds the same position, and it continues exposed along the creek—partly in place, partly tumbling—through the east part of section 9 and the west part of section 10, overlaid with dark argillaceous slates and shales.

On a small branch on the south side of Raccoon creek, at Snyder's quarry, in the southeast part of section 9, we find the next higher strata; first, four inches of black slate, then six inches of stone-coal; above that twenty feet of sandstone, and then shaly arenaceous strata, which latter are also struck in wells nearly at the edge of the Nine-mile prairie. The sandstone forms heavy beds, and, when freshly quarried, it is bluish gray, but after long continued exposure it often turns yellowish-brown. Some of it is slightly calcareous, but most of it is purely arenaceous. It is well adapted for building purposes, and dresses well, although some portions are harder than others. On its horizontal partings we find much mica, and traces of vegetable substances. It apparently corresponds to No. 1 of the above section, but is more purely sandy. The coal there corresponds to the seam at Central City, in the bank of Crooked creek. Although it is not thick enough to be mined alone, it is saved in the quarry and sold at Centralia.

Farther up Raccoon creek I only noticed a few layers of sandstone in its bank, in the south part of the northwest quarter of section 14, township 1, range 1; and then, for several miles, no rock at all, except a few tumbling sandstones near the bend of the creek, close to the line between range 1 and range 2.

Central City occupies the southeast quarter of section 6, township 1, range 1. At the north side of the town, only a short distance south of the creek, a shaft was sunk in 1857. No detailed record

has been kept, and the statements which I have been able to obtain in relation to the undertaking are meagre and unsatisfactory, and those of different persons do not agree fully. The following appears to be reliable: The shales, No. 1 of the above section, were struck at a depth of fifteen feet, and continued thirty-five feet, with an intercalation of eighteen or twenty-four inches of the fossiliferous, calcareous sandstone, No. 2. Then, at a depth of fifty feet, ten inches of coal was found, the same which crops out at the ford near by; after that, principally shales, which were partly arenaceous, and some shaly sandstones and concretions of carbonate of iron. At a depth of ninety feet another bed of hard rock was struck, apparently also a calcareous sandstone, and then more shales and the like. At a depth of one hundred and ten feet sandstone was found, and at one hundred and eighty feet a second seam of coal, twelve inches thick. One account says that some feet above this coal a foot of limestone was penetrated; while one of the laborers who worked in the shaft assured me that, about thirteen or sixteen feet above the coal, say one hundred and sixty-six feet below the surface, four feet of hard blue limestone occurred. If he is correct, this limestone would appear to correspond to the Shoal Creek limestone of the Clinton county report, which is further made probable by the report of the boring at the machine-shops of the Illinois Central Railroad, at Centralia, of which I will speak below.

Ten feet below the coal, at a depth of one hundred and ninety feet, the sinking was discontinued, and they bored one hundred and eight feet deeper, to a depth of two hundred and ninety-eight feet, when a weak brine was struck, which rose in the hole to seventeen feet above the bottom of the shaft. The undertakers then abandoned the work, thinking that they had penetrated through the whole of the Coal Measures to the lower formations. This idea is certainly unfounded. In the first place, we know from our examinations farther west and south that the strata in this vicinity are high up in the Coal Measure series, several hundred feet above the horizon of the DuQuoin and Belleville coals. Further, all the strata which were penetrated are exactly such as we would expect to find in this upper division of the Coal Measures, and decidedly different from those of the underlying formations, which we would expect to find composed principally of heavy masses of limestone, or perhaps thick bodies of sandstone. Nevertheless, the boring might have come, at its lower end, to a protruding body of the lower formations, and the lower portion of the Coal Measures might be wanting here; but this conflicts with the results obtained at Centralia, only two miles

farther south, where a boring was carried to a far greater depth, and coal was still struck over six hundred feet deep. The mere presence of salt water does not by any means prove that the Coal Measures have been entirely passed through, and I am most decidedly of the opinion that it has not been done. The brine may originate within the Coal Measures, or, more probably, in the lower Carboniferous formation, from which it may have risen in a fissure, or water-vein, into the higher strata in which it has been struck. This is more probable, because it is reported to have been weak, apparently mixed considerably with fresh water. Unluckily, the shaft is not any longer accessible, or else it would be interesting and important to make further examinations.

Centralia is situated a short distance south of Central City, principally in section 18, but extending into sections 7, 17 and 19, of township 1, range 1. The Illinois Central Railroad depot and machine shops are southwest of the center of section 18. In many wells in the town, water is obtained in quicksand, while shales are struck in all deeper ones at twenty feet or more. These shales are very finely arenaceous, micaceous and slaty. The railroad company tried to obtain water by an artesian well, and bored, for that purpose, at their machine shops, a six-inch hole, to a depth of eight hundred and sixty-four feet, in 1857 and 1858, without, however, succeeding in their object. If all possible care had been taken to obtain, at the same time, a correct account of the strata which were passed through, such a record would be of inestimable value in settling some pending questions in relation to the geology of this part of the State, and of direct benefit to the company in determining the prospects for opening coal mines along their road. Sufficient attention, however, seems not to have been paid in determining the thickness and quality of every stratum. A journal has been kept, which must contain some valuable data. I was informed that it was packed away with the other old documents of the company, and I was unable to gain access to it.*

South of the Nine-mile prairie, in which Centralia is situated, toward the Jefferson county line, and in the southeast part of this prairie itself, sandstones and shales have been found at various points. In sections 31 and 32, township 1, range 1, and also beyond

*For the following section of this boring, we are indebted to Mr. Thomas Tijou, of Wall's colliery, at DuQuoin. How much reliance is to be placed on the reported thickness and character of the beds passed through, we can not say; but from the fact that the railroad company have made no effort to open up the six-foot seam of coal, reported to be only two hundred and twenty-two feet below the surface, it would seem that they did not rely

the county line in this vicinity, sandstones have been occasionally quarried at several points. They are mostly purely arenaceous, but partly calcareous and very hard; and, besides, we find some shales. On the upper course of a branch of Grand-point creek, in the northeast quarter of section 32 (?), I observed some slaty shales, with a thin impurely calcareous layer. Sandstones have been struck in several wells on the south side of the prairie, especially on elevated prairie hills—for example, in the southeast quarter of section 28, and farther west. On a shallow prairie ravine, in the northwest quarter of section 27, arenaceous shales and some sandstones are exposed, and also on another branch in the east part of section 26. In the timber east of the prairie, I noticed a large mass of the hard, bluish, calcareous sandstone, near a branch of Raccoon creek, in the east part of section 25. The whole country is evidently underlaid with this formation.

Thence east, we come to a district in which coal has again been observed at numereous points. Near the range line, in the northeast quarter of section 36, township 1, range 1, northeast of Walnut Hill, in a ravine at the edge of the high prairie, arenaceous shales and thin layers of sandstone are exposed. Some of this sandstone

---

fully on the truthfulness of the statements made by those who were placed in charge of this important work. But the recent discovery of coal in the boring at Xenia, in Clay county, at a depth of only two hundred and fifty feet, renders the report of this boring the more probable, and if the Belleville coal was found here at all it would probably not be much more than five hundred feet below the surface. A. H. W.

	FT.	IN.		FT.	IN.
Blue clay, yellow sand, etc	Thickness, 20	6	Total depth, 20	6	
Sandstone	1	10		22	4
Blue slate, light color	10	—		32	4
Blue slate, dark color	55	8		88	—
Bituminous shale	—	8		88	8
Hard blue clay, mixed with gravel	3	6		92	2
Blue shale [slate]	25	6		117	8
Soapstone [probably indurated clay]	91	4		209	—
Limestone	7	—		216	—
Bituminous coal	6	—		222	—
Soapstone	12	—		234	—
Lime rock	6	—		240	—
Soapstone	93	6		333	6
Bituminous shale	2	—		335	6
Coal	3	—		338	6
Limestone	20	—		358	6
Soapstone	151	—		509	6
Sandstone	25	—		534	6
Black slate	6	6		541	—
Soapstone	65	—		606	—
Iron stone, very hard	3	6		609	6
Soapstone	247	6		857	—

is good for building purposes, although in thin layers. A short distance down that branch, near the northeast corner of section 36, we find a seam of coal, apparently only eight or nine inches thick, free from slate, and capped directly by shales. It is known as Marc. Cameron's seam, and has been used occasionally for blacksmithing. From the following it will appear that this coal seam is the seam which we have found on the East Fork, in township 3, range 1, and at other points, although here the usually accompanying calcareous rocks and slates do not appear to be developed.

Three-quarters of a mile farther east, near Andrew Cobbel's place a quarter of a mile west of the northeast corner of section 31, township 1, range 2, I found the same sandstone strewn in the breaks, and the coal exposed in a ravine not far below the summit level. It has been dug here to a limited extent, as it is of good quality, although it is only from eight to ten inches thick. In some places the shales cap the coal directly; at others, I observed the highly fossiliferous black calcareous slate above it, which we recognize at once as the roof-slate of the coal on the East Fork. Limestone has been burnt close by, either from points where the calcareous slate has changed into limestone, as we frequently find it in connection with this coal seam, or, possibly, from a calcareous layer which may exist a few feet below the coal, and corresponds to similar but less purely calcareous layers below the coal on the East Fork. This same limestone occurs also at other points in the vicinity, and I observed a ledge of it on the slope south of Raccoon creek, in the middle of section 29, where it is of a whitish color, and full of indistinct fossil remains.

The coal has also been struck in a well close to the county road, on the west side of section 28; but I could not learn the particulars. Sandstones crops out on the branch a short distance east of this, and on Raccoon creek sandstone and shales, apparently lower than the coal, are exposed in the east part of section 29; while, farther down the creek, for miles, no rocks crop out in its banks. Up the creek, in the north part of section 28, I also noticed shales and some sandstones, and above them, traces of the coal. There I also observed masses of a calcareous mudstone, such as I had seen near Central City and on the East Fork, which here contains some carbonaceous substance and curious petrifactions, apparently of roots of coal plants, which may, however, be of animal origin.

At the great bend of the creek, in the northwest quarter of section 27, sandstones occur—partly shaly, partly firmly cemented—overlaid with shales; and above them the coal is capped with the

black slate; but the coal was not sufficiently exposed to determine its thickness. Near by, I noticed tumbling pieces of a hard calcareous sandstone, with fossils. Sandstones of various qualities, soft or hard and calcareous, are found at various points through section 22.

In the northeast quarter of section 22, the coal has been dug in the bed of the creek at various points, a quarter of a mile west of the Salem and Mount Vernon road. This place is known as Mercer's diggings. All the holes were full of water, so that I could not see the coal in place. It is said to have measured from twenty to twenty-four inches in thickness. The top coal appears to have been slaty, while the lower part of the coal was firm and good. It is overlaid with black laminated slate, most of which is pure, while some of it is calcareous and highly fossiliferous, and changes at some points to a limestone. In this slate I noticed some lumps of iron pyrites; but the coal seems to have been rather free from it. Above the slate, follow shales, with some iron ore and then sandstone.

The same coal has been dug to some extent on a branch a short distance south of the creek, south of the center of section 22, where the roof consisted of the black laminated slate. I noticed there, also, traces of a Conglomeratic layer, which I found more developed some miles farther north, near the same coal-bed.

The coal is reported to have been found, also, in digging a well north of Raccoon creek, at the southern edge of the Tennessee prairie, near the middle of the east line of section 20, at a depth of eighteen feet, and said to be two feet thick.

Higher up Raccoon creek, sandstone (apparently the higher one) crops out at the crossing of the Mt. Vernon and Salem road, on the east line of section 22, and again, a quarter of a mile farther up, in the northwest quarter of section 23. Then, no more rocks are exposed on the creek, to its head. South of the creek, the upper sandstones are noticed in the breaks near the meeting-house of the Covenanters, east of the center of section 33, township 1, range 2; and shales were struck in a well near the county line, on the post-oak flat, near the southwest corner of section 35, and in the little prairie east of the center of section 26.

Farther north, sandstone, apparently that above the coal, has been struck in several wells, at a depth of from twelve to twenty-five feet, at the northwestern edge of the southern arm of Romine prairie, in the southwest quarter of section 11, or the northwest quarter of section 14, and in the southwest quarter of section 2,

township 1, range 2. It has never been penetrated more than a few feet. Undoubtedly, shales and coal would be found underneath it.

West from there, at the northeastern edge of Tennessee prairie, the same coal seam has again been discovered, at Mr. James J. Richardson's, in the northwest corner of section 9, township 1, range 2, extending, evidently, under the adjoining lands. The coal has there been dug, to some extent, in the bank of a small ravine, and in a shallow shaft. It is from eighteen to twenty-two inches thick, and of fair quality. It contains little sulphuret of iron, but some of the fibrous, or so-called mineral charcoal. The horizontal lamination and vertical partings are strongly developed. Below the coal is a hard rock, of what kind I could not ascertain; probably, a calcareous sandstone. In the shaft, the roof of the coal consisted of three feet of black slate, which was partly calcareous and full of fossils, but there was no limestones. Higher up, followed gray shales, with some concretions of carbonate of iron. On the ravine near the shaft, however, as much as eight feet of slaty gray limestone is exposed above the slate, which is there much thinner. Between it and the limestone, which is divided into large, square blocks, a mixed, shaly areno-calcareous layer is intercalated.

The coal has also been found at several points south of Crooked creek, in sections 33 and 34, township 2, range 2. It has been dug on a ravine at the edge of a little prairie near Mr. S. Hoff's place, in and near the northeast corner of the southwest quarter of section 34. The highest rock there is a soft sandstone, of which about four feet are exposed. Then follows only a few inches of shale, then twenty inches of black laminated slate, and from twelve to fourteen inches (and at one place twenty inches) of coal, which is apparently of good quality. In the black slate I noticed some concretions of iron pyrites. At some points it becomes calcareous, and is then either full of calcareous fossils, or contains heavy concretions of limestone, or even an irregular bed of the same material.

The coal is also exposed on a ravine in the northwest corner of section 34, and in the northwest quarter of section 33, and has been worked on Mr. Sanders' place, in the northeast quarter of section 33, in a ravine at the edge of a post-oak flat. Here the upper sandstone is again harder, and encloses in its lower part many carbonaceous particles and impressions of coal-plants. Its lower one or two feet are, in some of the diggings, mainly composed of ferruginous or calcareous nodules, and irregular streaks of slate, so that it assumes a curious conglomeratic appearance, traces of which I had

before noticed near Raccoon creek, in section 22, township 1, range 2. The shales below the sandstone are here hardly represented. Then follow the slates, which at some points are three feet thick, at others hardly one foot. As they decay rapidly, the fossils can not be readily preserved, except when they are taken from newly dug slate. Of solid limestone, I saw here only traces. The coal below the slate has the same thickness and quality as at Hoff's.

Following down the ravine to Crooked creek, and down the latter, I find in the southwest quarter of section 28, township 2, range 2, several outcrops of sandstone and abandoned quarries, and a large quarry is now worked on its bank, in the southeast quarter of section 29. The quarry rock is there twenty-five or thirty feet above the creek, rather soft, finely grained, and a little micaceous. It is only a few feet thick, while most of the strata above and below it appear to be shaly. Down the creek we can trace these sandstones into section 31, although they are little exposed. No traces of the coal or slate were observed, nor any rocks, farther down for several miles, except drift boulders and some tumbling pieces of the fossiliferous, more or less calcareous sandstone. On Crooked creek, above section 28, no rocks have been discovered in place to its very head, nor on its branches, although they extend east of Salem, and head near Alma.

Salem is situated in section 11, township 2, range 2, near one of the branches of Crooked creek, at the edge of the prairie. Water is obtained there in shallow wells, and no rocks have been struck in digging.

At the west edge of Romine prairie, near the Salem and Fairfield road, in the east part of section 32, township 2, range 3, shales have been struck in a well, while most wells in this vicinity pass only through Quaternary deposits. North and east from there, however, on a high prairie ridge, in the southeast quarter of section 29 and section 33, and, probably, also, farther south, sandstone has been struck in wells at a small depth. On a high point of this ridge, in the southeastern part of the prairie, near the middle of the east line of section 16, township 1, range 3, at the head of a ravine, several feet of a strongly cemented, hard calcareous sandstone crops out, which is inclined to be shelly, and can not be dressed. Near the southern edge of the prairie, sandstone has been struck in many wells. In the southeast quarter of section 22, township 1, range 3, it is from five to fifteen feet below the surface, and so also in the southeast quarter of section 21, and farther west near the middle of the north line of section 29, and in the southeast quarter of section 30.

South of Romine prairie, sandstones crop out on a branch of Big Muddy river, in the south part of section 32, township 1, range 3, near the county line; and also at various points in the timbered hills farther east, where sandstones or shales are generally found within a few feet of the surface. In this vicinity, northwest of the center of section 33, some coal has been discovered on a small branch. There, at the head of the breaks, I found sandstone; and lower down, a ledge of the hard, strongly-cemented sand-rock, which appears to change into a rock of a Conglomeratic appearance, such as was observed at Sanders' coal-bank, near Crooked creek, and at one point here it is two feet thick. Then follows a little shale, a mere trace of slate, and then the coal. It is said to have been found at one point nine inches thick; but is not now exposed there. Close by, I noticed two inches of coal, which seemed to be, however, a few feet higher than the main seam. Some fragments of the coal, strewn about there, differ in appearance from the coal of the other diggings. It is hard, somewhat slaty, with sub-conchoidal fracture, like an impure, very slaty cannel-coal, and heavy from a large amount of earthy matter. There also seems to be considerable pyrites, and a small chalybeate spring issues near the coal. I could not fully satisfy myself whether this is the continuation of the coal-bed of the East Fork and Raccoon creek, although I suppose it is. Sandstone seems to be much stronger developed, and to prevail over the other rocks in the southeastern part of the county, although the formation is still the same as father west.

On Horse creek, in the southeast part of township 1, range 3, between Romine and Donnehue prairie, sandstone crops out at a few points, and the hills are underlaid with it; but the banks of the creek are generally formed of high alluvial clay banks, and show only tumbling rocks.

At the eastern edge of Romine prairie, on the waters of Fulton branch of Skillet Fork, coal has been discovered at several points. Northeast of the center of section 10, township 1, range 3, sandstone crops out at the head of a branch of this creek, the lower portion of which presents a conglomeratic appearance, it being formed of a mixture of sand, lime, nodules of brown oxyd of iron, and flint pebbles, with traces of fossils and particles of carbon. Lower down the branch, some black slate was exposed, and below it gray shale. Some fragments of a slaty coal were also noticed, but it is not exposed in place here.

It has been discovered a mile farther down the branch which runs near the edge of the prairie, near Mr. William Hill's place, in

the northwest quarter of section 2. There it has been laid bare on a hillside, and has been dug into, also, on the south side of the creek. It was evidently only a few inches thick, with only a little slate above it, and capped with arenaceous, shaly rocks. In the bank of the creek, a few feet below the coal, some sandstone crops out, which is finely adapted for building purposes. A quarter of a mile farther northwest the coal has again been dug into, but with no better result.

Farther north, on another branch of Fulton creek, in the north part of section 34, township 2, range 3, sandstones are prominently exposed at the edge of the prairie, and I noticed in them, at one point in the face of the bluff, a small pocket of coal, about two feet long by four inches thick at the thickest. I am told, however, that near by some six inches of coal crops out, and forms a regular layer. In these instances I am at a loss to determine whether this coal forms the continuation of the East Fork coal or not, although I am rather inclined to think that it does. East, northeast and southeast from there no further signs of coal have been discovered in this county.

Down Fulton creek to its mouth. outcrops of rock are quite scarce, but sandstones and shales were noticed at a few points in its banks; and the flats and barrens north and south of it are underlaid with the same rocks, which have been observed at various points.

On the upper course of the branches of Fulton creek, at the south side of the Middleton prairie, sandstone is very largely exposed in the southeast quarter of section 27, and in the south part of sections 23 and 24, township 2, range 3, and farther east, on the branches south of Middleton, on the east side of section 19, township 2, range 4. These rocks are partly soft and rather massive in their structure, and at some points they crumble so easily to sand that they are hauled away for plastering.

In the prairie north from there the sandstone has been struck in many wells in the east part of section 15, in the southeast quarter of section 14, in the southwest quarter of section 13, township 2, range 3; also at New Middleton, in the northwest quarter of section 17, township 2, range 4, and at other points. The wells here frequently pass forty feet deep through more or less pure sandstones, which begin not more than ten or fifteen feet below the surface.

On the small branch of the Skillet Fork, north of Middleton, this sandstone is exposed continuously for about two miles, in the south-

west quarter of section 7, and in the south part of sections 8 and 9, township 2, range 4. It is partly soft and massive, partly harder and more thinly stratified. The cliffs along the branch become higher as the stream descends eastward. They are at many points twenty-five or thirty feet high from the water's edge; and the aggregate thickness of the sandstone, without any shales, must be fifty feet or more. At its lower end, intercalations of shales make their appearance; then the outcrops are farther apart; and finally, in the middle of the south half of section 9, the last exposure on the branch consists of shales. The uplands in this vicinity, and also on the other side of Skillet Fork, near the former town site of Fredericktown, in the center of section 11, and on the west and south sides of Ramsey's prairie, and north toward Conner's prairie, are all underlaid with these sandstones, although they are very sparingly exposed.

On Skillet Fork no rocks are exposed for several miles above the Ohio and Mississippi Railroad, and for over a mile and a half below it. The first exposures south of the railroad are found in the southwest quarter of section 22, township 2, range 4, where about ten feet of rather massive sandstones outcrop at the water's edge. Thence down for about a mile there are several similar exposures, the last one in the southeast quarter of section 28; and also some prominent sandstone cliffs, on a little branch on the east side of the Skillet Fork, known as the rock-house branch. The next rocky bluff is found two miles farther south, in the southeast quarter of section 3, township 1, range 4. It is similar to the first one, but higher, and somewhat shaly at its base, while more sandstones crop out higher up in the hills. It extends, along the west bank of the creek, to Songer's mill, which is close to the south line of the section, where it shows alternations of sandstone with much shale, and for about a mile beyond, through the west half of section 11.

A mile farther on we find another outcrop of sandstone at the water's edge, close to the mouth of Paint-rock creek, in the northwest quarter of section 22. Then there are generally bottoms on both sides of the creek, and the sandstone is only exposed farther off in the hills, except in the northwest quarter of section 26, where it again crops out in the bed of the creek. In the southeast corner of the county the same rock forms several prominent cliffs on the southwest side of the creek; at the mouth of Branson's branch, near the middle of the west line of section 36, township 1, range 4, where it forms a vertical cliff twenty-five feet high from the water's edge, with more of it in the sloping summit of the hill; and on the

east side of that section, near the county line, another, the so-called Beech bluff.

West from this, toward Donnehue prairie, in the south part of township 1, range 4, the sandstones crop out at various points on Branson's branch, and in the barrens; and they are prominently exposed at the head of a branch of Paint-rock creek, at the northeast corner of Donnehue prairie, in the northwest quarter of section 29, or in the northeast corner of section 30. Along Paint-rock creek (which takes its name from lumps of sulphuret of iron which are occasionally found on it, and in their decomposed state are used by the farmers for dyeing), the sandstones likewise form numerous cliffs and smaller outcrops, in sections 21, 20, 17, 18, and at some points higher up toward Romine prairie. The whole formation is apparently below the coal-seam of Raccoon creek and the East Fork.

Dom's creek heads about three miles east of Alma, in the north part of township 3, range 3; then runs south to near the Ohio and Mississippi Railroad, and then turns east into the Skillet Fork, in the east part of section 10, township 2, range 4, a short distance north of the railroad bridge. For over a mile above its mouth no rocks crop out in its banks; and the first ones seen are some sandstones in the middle of section 4. Then I noticed several exposures of shales with concretions of carbonate of iron, overlaid with sandstones, in section 5. Some miles farther west, at and below the bend of the creek, sandstones are also exposed in its bank, and have been quarried to advantage in the southeast quarter of section 10, and all through section 11, township 2, range 3, and perhaps farther down.

Below the bend sandstones are also largely developed in the adjoining hills. They have been quarried in the Tadlock branch, in the east part of section 2, and crop out, together with arenaceous shales, near the county road, in the east part of section 11 or west part of section 12. A short distance above the bend gray shales form the bank of the creek, at an old mill-seat in the northeast quarter of section 10; but thence upward very few rocks have been discovered along it. The next are on a small branch west of Dom's creek, in the southeast corner of section 33, township 3, range 3. They are likewise sandstones, rather hard and irregularly stratified. These, together with shales, have also been struck in digging wells in this vicinity. Near the middle of the adjoining section (34), some sandstone is said to be exposed in the bank of the creek; and farther up, at the bridge near the north line of the northwest quarter of section 35, I found, in the bed of the creek, some shales,

overlaid with two inches of an impure limestone, full of fossils—*Myalina, Gasteropoda,* stems of *Crinoidea,* etc.—while above it lay heavy blocks of a similar limestone, which had evidently been once in place in the higher part of the bank. This is undoubtedly the same bed of rock which I afterwards found northeast on Bee branch, and at other points, corresponding to similar limestones in the vicinity of Raccoon creek, which are there closely connected with the coal seam, generally above it, but others in some places below it. Thence up for several miles no outcrops whatever occur on Dom's creek, except near its head; but shales and shaly sandstones have been struck in several wells in the prairie west of the creek, in the south part of section 27. township 3, range 3, from fifteen to twenty-five below the surface, and in a well near the middle of the west line of section 27 (?), on land belonging to Mr. Warner, sandstone is reported to have been struck at less than twenty feet, and underneath it some inches of stone coal.

On the upper course of Dom's creek, east of Alma, near the middle of the west side of section 10, township 3, range 3, the East Fork and Raccoon creek, coal has been discovered and dug into near Mr. Wilson's. The coal has been dug in the bed of the creek, and is reported to have been from eight to ten inches thick, and of good quality. Fragments of the black slate and of the coal were lying about, which presented the ordinary appearance of the East Fork coal.

East of Dom's creek, at the upper end of Red-lick prairie, above the head of Bee branch, in the middle of section 13, township 3, range 3, shales, with concretions of carbonate of iron, were struck, at a depth of only ten feet. On Bee branch, on both sides of the range line, near the southeast corner of section 13, several feet of bluish shales crop out, capped by four inches of limestone, which is dark red, or, at other points, red, from the oxydation of iron, and contains fossils. Some feet below the limestone, the shales turn to dark blue slate, which has been dug into; and I have been informed that some coal had been obtained there, but I could not fully satisfy myself in regard to it. At any rate, the coal must have been thin. The rocks dip toward the southeast, down the branch. At the head of the next prong of the branch, farther south, we find some sandstone and shales, which apparently overlie the above mentioned strata, of which no trace is to be found here. A few rods down the branch, in the northwest quarter of section 19, township 3, range 4, gray, somewhat arenaceous shales, with kidney iron ore, are exposed, and continue some distance. Still farther, in the south-

west quarter of section 19, limestones crop out in the bank of the creek, underlaid with some arenaceous shales and shaly sandstones, and continue more or less exposed to near the north line of section 30 (?). These limestones are several feet thick, of grayish color, hard and impure, apparently considerably mixed with mud, and thus analogous to the calcareous mudstones in other parts of the county. They evidently correspond to the above mentioned limestone on Dom's creek, and to that at Hensley's coal bank, three miles farther northeast, and it would seem probable that they also form the continuation of the four inches of limestone at the head of Bee branch, which is perhaps their lowest layer. In section 30, these rocks disappear, probably rising to a higher elevation, and along the creek we then find arenaceous and argillaceous shales, overlaid with some heavy layers of sandstone, some of which are good for building stone. Similar rocks are still exposed in the northeast quarter of section 31, but thence down to its junction with Dom's creek, no more outcrops of any kind are found on this branch. Tumbling pieces of limestone similar to that on the creek, together with sandstones, were observed at various points on the slopes west of the creek, at the edge of Red-lick prairie, from section 24, township 3, range 3, not far south of the head of the creek, to the north part of section 31, township 3, range 4, near the southeast corner of the prairie.

Farther east, hardly half a mile south of Omega, near the middle of the south half of section 17, township 3, range 4, at the head of a ravine, the bank consists of arenaceous shales, while a few yards lower down I observed large slabs of a red limestone, the same layer which I had noticed at the head of Bee branch.

East from there, on both sides of the Skillet Fork, only sandstones and shales were discovered, the same as on the lower course of Bee branch, which underlie the limestone and the East Fork coal seam. In the timber near the southeast end of Lowell prairie, especially in the southwest quarter of section 27, township 3, range 4, sandstones crop out on some ravines, and in a well dug in the southeast quarter of section 27, near the bank of the Skillet Fork, shales were struck, with concretions of carbonate of iron. No outcrops of rocks have, however, been observed on that stream from below the railroad to near Critchfield prairie, a considerable distance above the mouth of the Lost Fork. At several points it runs past high and steep banks, but these consist of alluvial clay, with only a few tumbling rocks and drift boulders. The only rocks observed east of the Skillet Fork in this vicinity are some sandstones in a

ravine near the west side of Conner's prairie, on section 25, which have also been struck in some of the wells of that prairie; and then some sandstones and arenaceous shales on Conner's branch, within half a mile of the county line, near the middle of the south line of section 36, township 3, range 4, and in the hills north and south of that branch, in sections 1 and 36.

On the Lost Fork, a quarter of a mile above its junction with the Skillet Fork, in the southeast quarter of section 22, township 3, range 4, I observed shales, with iron ore in the lower part of the bank, and close by, some twenty-five feet above low water, several feet of sandstone, of good quality for building purposes. Similar sandstones crop out farther up the creek, especially in the southwest quarter of section 10, and farther towards its head and on its branches, also near the edge of Lowell prairie, near the northwest corner of section 22, near the middle of the north line of section 16, and at other points.

In the northwest quarter of section 9, township 3, range 4, on a branch of Lost Fork, not far from the edge of the prairie, is Hensley's lime quarry and coal mine. The branches and lower part of the hills here exhibit numerous outcrops of arenaceous shaly strata, with some intercalated ledges of fine sandstone, which extend, also, up the branch, into the south part of section 5, and up the main creek through section 4, and far beyond. In the southeast quarter of section 32, township 4, range 4, sandstone has been quarried from this bed for building culverts on the Illinois Central Railroad, near Kinmundy. Above these strata at Hensley's, there is a little clay shale, then a thin parting of slate, and a layer of stone coal, which is about ten inches thick, of which eight inches is good coal, and then limestone in heavy blocks, which is fully five feet thick, where it is well developed. The coal is somewhat rotten at the outcrop, but better where it has a heavier cover. It is precisely of the same general character as the coal from the East Fork; is inclined to laminate; rather free of sulphuret of iron, and is advantageously used in an adjoining smith-shop. The limestone is very hard, of a grayish color, and quite impure. It can be burned, but makes a gray lime, which is, nevertheless, extensively used in the neighborhood, lime being scarce. This limestone is not quite as impure as that on Bee branch, which is evidently the same stratum, although the coal has not been discovered there. There can be hardly a doubt about its also forming the continuation of the limestone which we have repeatedly observed on the west side of the prairie, north of Alma, and again near Raccoon creek, and at other

points above the East Fork coal seam, which at other localities is represented merely by irregular concretions of calcareous matter, or by a large admixture of the same to the roof slate of the coal seam. The coal can be profitably worked at this locality only in connection with the limestone quarry, and is most convenient for burning the lime. This limestone and coal crop out again on the other side of the hill, near the center of section 9, and the limestone, also, at Mr. Joseph Lewis', in the northeast quarter of section 8, where the coal is not exposed.

Farther southeast, the underlying sandstone and shales alone appear to be found, except at a single place, in a ravine, on the east side of Lost Fork, in the south part of section 15, where the limestone is said to occur in tumbling masses, and to have been burnt some years ago. Farther northeast, I observed some tumbling blocks of apparently the same limestone, on the road north of Omega, near the southwest corner of section 5, which indicates the presence of these strata in the hills of this county. Again, two miles south of east of Kinmundy, near the head of one of the branches of the Lost Fork, on the east side of the prairie, in the northeast quarter of section 23, township 4, range 3, similar limestones protrude in such quantity from the sloping bank, that I am satisfied they range through here underground; the more so, because the limestone and coal were not only observed some miles west from there, on the branches of the East Fork, but also farther east, on the branches of the Skillet Fork. At that point, in section 25. the limestones are partly rather pure, partly highly arenaceous, even exhibiting a change into a flinty calcareous sandstone. Below them, in the branch, shaly arenaceous strata are largely exposed. No trace of the coal has here been observed, but it would most likely be found, if search was made for it by digging at the proper point.

A very curious exposure was observed on the east bank of the Lost Fork, in the northwest quarter of section 32, township 4, range 4. Shaly sandstones and arenaceous shales are variously exposed on the creek in that vicinity. At the point in question, on Mr. Griggs' place, fifteen or twenty feet of such strata form the base of the hill, with an irregular seam of coal in the lower portion, which varies between three and ten inches in thickness. There is no slate with the coal; but in places the shale next above the coal contains thin shells of limestone, and the coal seam itself incloses more or less calcareous masses, which, upon examination, proved to be mainly composed of the same curious fossils which I had observed

before, in the horizon of the coal seam on Raccoon creek, and which is either of coralline origin, or some petrified vegetation. I am not fully satisfied whether this coal seam is the continuation of Hensley's and the East Fork seam, but think it highly probable.

Near the Clay county line, on the south and southeast side of Critchfield prairie, the first rocks are again found on the Skillet Fork, which for miles below that point runs between banks of clay. First, near the south end of the prairie, we find tumbling sandstones in the slopes; then, in the southeast corner of section 12, township 3, range 4, near the southeast corner of section 1, and at other points, we observe in the banks of the creek and on the ravines, solid layers of sandstone, with shaly strata, as on the lower course of the Lost Fork. Near the center of the southeast quarter of section 36, township 4, range 4, not far from Mr. Lutterel's, I observed at the water's edge an outcrop of limestone, which presents an exposed thickness of more than two feet, of grayish color, partly hard and siliceous. Above it follow four feet of black laminated slate, which changes upward into shale. Mr. Lutterel informs me that, digging in the bed of the creek, he came to coal about three feet below the lower exposed edge of the limestone. A little farther down the creek the shale and slate again form the bank, with some limestone at the water's edge. Some coal, apparently identical with the East Fork coal, was noticed there, which seemed to have been dug up at this point; but I could obtain no additional information.

On a small branch of the Skillet Fork, north of Critchfield prairie, in the northeast quarter of section 26, township 4, range 4, I found several feet of argillaceous shales, and above them a few inches of coal, which is rotten at the outcrop, and has not been dug into, so that its thickness and quality can not be determined positively. It appears to be quite thin. Then follow several feet of dark-blue slates, and some tumbling pieces of limestone, which latter was not observed in place in this vicinity. The whole reminded me strongly of the outcrop on the Lost Fork, three and a half miles farther west. North from there, near the edge of Grand prairie, in sections 23 and 14, I observed at various points shales and sandstones, some of which are a very good building material. All the above enumerated exposures of coal and limestone near the Skillet Fork would seem to be outcrops of the same strata, and moreover, to form the continuation of the East Fork coal and the strata connected with it, although they differ from them in their local development.

Economical Geology.

Stone-coal.—I have already stated that the geological formation of this county comprises only an upper division of the Coal Measures, and that there are, therefore, prospects for coal not only in the strata nearest to the surface, but also at a greater depth. The foregoing description of all the outcrops in different portions of the county shows that the larger portion of the county is underlaid at a small depth with a seam of stone-coal, the thickness of which varies from a few inches to two feet, and the quality of which is in most instances very fair. This coal seam may be worked profitably at numerous points for supplying the local demand, especially where it can be stripped along its outcrops, and even by regular mining operations, where it is thickest. The following table contains an enumeration of all places where this coal has been discovered, with its thickness at each point where it could be ascertained:

Number...	Name.	Township.	Range.	Section.	Quarter.	Thickness — *Inches.*	Remarks.
	Casey's mill	3	1 W	..	In Clinton Co.	12	On East Fork, half a mile west of the county line; is the same as the following:
1	Hawkins	3	1 E	10	Center		In a well north of East Fork.
2	On East Fork	3	1	12	Middle	18	At the mouth of Jim creek.
3	On Jim creek	3	1	12	Middle	18	Close to East Fork.
4		4	2	32	Middle S line		South of East Fork.
5	Smith's	4	2	33	NE corner		On East Fork.
6		4	2	34	W of NW	18	" " "
7		4	2	34	NW		In a well on the upland.
8	Wilden's	4	2	27	SW of center	18	On East Fork.
9		4	2	26	Middle S line		Branch of East Fork.
10	Strickler's mill	4	2	25	NW	16	On East Fork.
11	Martin's	3	2	1	SE	15 (?)	Near Alma.
12	B. Howel's	4	3	31	N of SW	14 to 18	Branch of East Fork.
13	— Howel's	4	3	29	S of SW	15 to 17	" " "
14	Pruet's	4	3	29	NE of SE	10	" " "
15	Central City	1	1	6	NE	12	On Crooked creek.
16	" "	1	1	6	Middle E half	10	In a shaft, fifty feet deep.
17	Centralia	1	1	18	NE of SW	8 (?)	In a boring, ninety feet deep (?).
18	Snyder's quarry	1	1	9	NE of SE	6	On branch of Raccoon creek.
19	Cameron's	1	1	36	NE corner	8 or 9	North of Walnut Hill prairie.
20	A. Cobbel's	1	2	31	N of NE	8 or 10	" " " "
21		1	2	28	W side		In a well south of Raccoon creek.
22	On Raccoon creek	1	2	27	NW		At the bend of the creek.
23	Mercer's	1	2	22	NE	20 to 24	On Raccoon creek.
24		1	2	..	S half		Branch of Raccoon creek.
25		1	2	20	Middle E line	24 (?)	In a well at S. edge of Tennessee
26	Richardson's	1	2	9	NW corner	18 to 22	Edge of Tenn. prairie. [prairie.
27	Hoff's	2	2	34	NE of SW	12 to 14 & 20	On drain south of Crooked creek.
28		2	2	34	NW corner		" " "
29		2	2	33	SE of NW		" " "
30	Sander's	2	2	33	NE	12 to 14	" " "
31		1	3	33	SE of NW	9 (?)	South of Romine prairie.
32	W. Hill's	1	3	1	S of NW	Thin.	Head of Fulton creek.
33		2	3	34	N	6 (?)	Branch of Fulton creek.
34	Warner's	3	3	27	Middle W line	Thin (?)	In a well in the prairie.
35	Wilson's	3	3	10	Middle W side	8 to 10	Head of Dom's creek.
36	Bee branch	3	3	13	SE corner	?	
37	Hensley's	3	4	9	NW	8 to 10	Northeast of Omega.
38	Mrs. Gregg's	4	4	32	NW	3 to 10	On Lost Fork.
39	Near Lutterel's	4	4	36	SE	?	On Skillet Fork.
40		4	4	26	NE	A few inc's	North of Critchfield prairie.
41		4	4	14	N	2 to 6	Branch of Skillet Fork.

These are the points at which coal has been found near the surface, and as all this coal appears to come from one and the same stratum, with, perhaps, the exception of the outcrops in the vicinity of Central City, of which I have spoken above, and of those at the head of Fulton creek, we may, of course, calculate to find the same seam at the intermediate points by digging for it, except where the lower strata reach the surface, as near the Skillet Fork. It is of great importance to know whether heavier coal-beds might be discovered in this county by digging to a greater depth, and this point can only be settled in a satisfactory manner by actual experiment.*

The area of the county is five hundred and seventy-six square miles. Each foot of thickness of a coal seam extending underneath the whole, would then be capable of affording an actual yield of two thousand eight hundred million tons of coal, or a six feet bed, a yield of seventeen thousand two hundred and eighty million tons of coal in the whole county. These figures prove the vast importance of positively ascertaining the existence of this coal bed. It is doubtful whether there is another coal seam of paying thickness at a still greater depth, although it is not impossible.

Iron Ores.—Iron, in the shape of kidney-ore, is disseminated in concretions, in larger or smaller quantity, through many of the shales of the Coal Measures. We have found it at numerous points in this county, as may be seen in the foregoing pages, but it is still doubtful whether it is concentrated at any one point in sufficient quantity to be profitably mined for the manufacture of iron.

Salt.—I could ascertain but little in relation to the quality of the brine said to have been struck in the boring at Central City, at a depth of near three hundred feet; but it was said to be rather weak, and no attempt has been made to manufacture salt at that point. This brine seems to have a deep-seated source, and a strong and good supply of it might possibly be obtained by boring deeper. In the boring at Centralia, two miles distant, no brine was discovered at even a far greater depth, nor have any traces of salt been found anywhere else in the county.

---

*A carefully conducted boring, carried down to the depth of six hundred feet, would probably settle the question as to the development of the Belleville or DuQuoin coals in this county, and if they are found here at all, their exploration and development will prove of great value to the people of this county, and it is a question of such vital importance that its final determination can not be very long delayed. The many outcrops of the small coal over the whole extent of the county, noticed in the foregoing pages, would seem to indicate conclusively that this county occupies a position so near the center of the Illinois coal-field, that the strata are very nearly horizontal in position, and, consequently, if these heavy coals exist here at all, they would be found at a nearly uniform depth over the whole county. A. H. W.

Building Materials.—Sandstones for ordinary building purposes, especially for foundations and common walls, may be obtained at numerous points in the county, and no place is more than a few miles distant from a quarry. Many of these rocks are of rather indifferent quality, but if proper search is made, single ledges of very good stone may be discovered at many points. Lime has been burned at several localities from the limestones in the vicinity of the coal seam, but these rocks are generally impure, and if a superior article of lime is wanted, it must be imported, for which the several lines of railroad offer facilities. The most prominent localities of limestone are near Raccoon creek, in the southwest part of township 1, range 2; on Bee branch, in the southwest part of township 3, range 4; near Lost Fork, in section 9, township 3, range 4, and on a branch of Skillet Fork, in section 36, township 4, range 4; but the limestones have been discovered at many other points near the upper coal seam.

Sand for plastering and mortar can be easily obtained on many of the creeks, because they run through sandstones and other arenaceous strata.

Timber and Agriculture.—In describing the surface configuration of the county, I have already stated the principal facts which come under this head. Nearly half of the county is timbered land, the other somewhat larger half, prairie. The timber land presents the same leading characters which have been discussed in the report of Perry county, comprising the post-oak flats, barrens, and so on. On the flats, the post oak still prevails, with often hardly any undergrowth on the white soil. In the barrens we find, together with a growth of white oak, black oak, barren hickory (*Carya tomentosa*), and other trees.

In the creek bottoms, especially in the wide bottoms of the Skillet Fork, and of the lower course of some of its tributaries, there is a heavy growth of choice timber, which is being cut in large quantities for staves, railroad ties, and lumber. It consists principally of the white oak proper (*Quercus alba*), which shows that these bottoms are at many points not wet land, although they may be occasionally overflowed; then the bottom white oak (*Q. bicolor*), sugar tree (*Acer saccharinum*), and on lower ground, various hickories, elm, maple, water oak (*Q. pallustrius*), and others.

These bottom lands, where they are not too low, have a deep, rich soil. The post oak flats and barrens have been described too often to require further remarks. The prairies in this county have, in part, at least, the same sub-soil which has been observed at

many points in Clinton county, and described in the report of that county as a white, finely-comminuted arenaceous loam, with ferruginous nodules and concretions, which sometimes form a hard-pan of considerable thickness. I have discussed its qualities and its influence upon the surface, soil, and growing crops sufficiently already, and need not advert to it again at greater length. It is certainly not a desirable sub-soil, but wherever the upper soil is deep, as is the case at many points in the prairies, this sub-soil exercises less influence, because the upper soil of the prairies is almost always rich in vegetable mould, and of great fertility. At some points this sub-soil contains whitish calcareous nodules in considerable quantity, for example, in the vicinity of Patoca, and it seems as if they had a favorable influence upon the quality of the land—at least they would neutralize any tendency to acidity, resulting from the great compactness of the soil, and keep it looser.

If the farming lands in this county can not be counted amongst the best in the State, still the facilities for marketing the produce are such, or might easily be made such, that the farmer can compete with richer districts. The Ohio and Mississippi Railroad brings the St. Louis market within easy reach, and affords, besides, a ready outlet to the east; while the two branches of the Illinois Central Railroad give an easy communication with all parts of the State, and especially with the Chicago market. Many fruit growers have already availed themselves of this advantage, and have planted fine orchards on the high, rolling prairies along this road.

NOTE.—Since the original report on this county was published a coal shaft has been sunk at Centralia, and at the depth of 576 feet a seam of coal averaging about seven feet in thickness was found. A. H. W.

CHAPTER VIII.

JEFFERSON COUNTY.

BY HENRY ENGELMANN.

Jefferson county is situated southeast of the intersection of the Illinois Central and Ohio and Mississippi railroads, and is formed by townships 1, 2, 3 and 4, south of the base line, in ranges 1, 2, 3 and 4, east of the third principal meridian, thus embracing sixteen townships, or five hundred and seventy-six square miles. More than four-fifths of this area, or about four hundred and sixty-six square miles, is timbered land, while only about one-fifth, or one hundred and ten square miles is prairie. This proportion of prairie is much smaller than in the counties farther north, and grows still less in the more southern counties.

These prairies present the same character as those in the adjoining counties of Perry and Washington, which have already been described at some length in the reports on those counties. They invariably occupy the more or less elevated lands between, and usually at some distance from, the creeks and water-courses, and have generally a considerable depth of Quaternary deposits, sometimes underlaid with shales. It is seldom that rocks are found in the prairies, even by digging to some depth, though at some places timbered hills occur in the prairie, which are underlaid with solid rocky strata, and rise above the level of the prairie, either within its bounds or at its edge. Knob prairie has its name from such a hill or knob.

The timbered portion of the county is partly flat, but most of it is undulating or broken, in consequence of the numerous water-courses which traverse the county in every direction. It has some post oak flats, also some wet flats at the edge of prairies, in which water oak predominates; but more oak barrens, with a growth of black oak, white oak, post oak, hickory, etc. The timber in the

creek bottoms is generally quite heavy, and consists of swamp white oak, water oak, sugar maple, sycamore, black walnut, white walnut, etc. In the extreme southeast part of the county, however, I observed an occasional tree of more southern affinity, such as the sweet gum.

The county is plentifully supplied with running water, principally by the branches of Big Muddy river, which head near the north line of the county, and traverse it in a southerly direction, with many smaller creeks which empty into them, both from the west and east. The main branch of Big Muddy river heads near the northwest corner of the county, some miles southeast of Centralia; while some other ravines near by run westward toward Crooked creek and the Kaskaskia river. The Little Muddy river passes through the southwest corner of the county. In the northeast part of the county is Horse creek, a tributary of the Little Wabash river, and all the branches on the east line of the county take their course eastward, toward the Little Wabash.

The geological formation of this county, like those of all the adjoining counties, are members of the coal formation. All over the county, with the exception of a limited area in the southwest corner, we find the same strata which we have traced all over the adjoining county of Marion—a sub-divison of the upper Coal Measures, including a coal seam which varies from six to twenty-four inches in thickness. At a greater depth we may expect to find the DuQuoin coal-bed; and the sandstones overlying this coal, and its associated limestones, have been traced over a considerable area east of the outcrop of the coal, and attain a considerable but variable thickness, sometimes amounting to more than two hundred feet, and appear to pass across the extreme southwest corner of Jefferson county. The sandstones on the Little Muddy, east of Tamaroa, are probably members of this formation.

The Shoal Creek limestone has no great thickness. It varies generally between seven and fifteen feet; but being the only prominent limestone between two heavy bodies of sandstone, it forms a well-marked horizon, and can be readily traced over a long distance. It passes across Clinton and Washington counties, toward the southwest corner of Jefferson. I have observed it near Highland, Jamestown, Breese, Carlyle, Nashville; farther southeast, on the waters of Beaucoup creek, and near Little Muddy river, not far from the railroad bridge north of Coloma. Still farther southeast, in Perry county, only a quarter of a mile from the Jefferson county line, on Little Muddy river just before it enters the latter county, we find an

outcrop of evidently the same limestone. Here five feet of it are exposed, covered with soil. The whole of it may possibly be thicker. It rests on one foot of shales, and three feet of black laminated slates, which reach to the water level. Coal, probably fifteen inches thick, has been dug from the bed of the creek.

From this point the Shoal Creek limestone must pass into Jefferson county, crossing the lower course of Bald creek and other affluents of the Little Muddy; but the county is mostly covered with heavy Quaternary deposits, and is thinly settled, so that artificial exposures are wanting; consequently exposures of any rocks are scarce, and the limestone has not been discovered. Higher up these creeks, and in the barrens, sandstones crop out at a few points, evidently the higher ones, especially in the southwest quarter of section 9, in the east part of section 17, in the northeast quarter of section 29, the north part of section 28, and the south part of section 21, all in township 4, range 1. It was only in a well in the southwest quarter of section 29, that, at a depth of thirty feet, the black laminated slate was struck. This is exactly where we should expect to find it, in the direct trend of the Shoal Creek limestone formation.

All the rest of the county is occupied by the higher sandstone formation, the same which covers the whole of Marion county. This formation consists principally of alternating layers of sandstone and arenaceous and argillaceous shales. At some points the sandstones are more purely quartzose, harder, and therefore more prominently exposed; at others they are subordinate, and the shales predominate largely. Almost everywhere single layers of the sandstone can be found of sufficient hardness and smoothness for building purposes. This formation, being part of the Coal Measure system, may be expected to contain some stone coal, bat it is not rich in this mineral. The only coal bed of any importance occurs at a considerable distance above its base, but extends, with remarkable uniformity, over a large area. I have discovered it at numerous points throughout Jefferson and Marion counties, and it undoubtedly extends much farther. It varies from six to twenty-four and even thirty inches in thickness, and may be said to average from 12 to 18 inches of good coal. It is of considerable local importance, being used extensively in this district, and has been opened at numerous points. At some places this coal is quite pure and free from sulphur; at others it contains much slate and sulphuret of iron. Where the bed is thicker it generally contains slate partings. At a few points the slate and carbonaceous matter are so completely mixed that the whole assumes a slaty appearance, and a semblance of cannel coal,

with conchoidal fracture. The coal is then, however, overcharged with earthy matter. The vertical and horizontal partings of the bed are generally well defined, and cross at nearly right angles, so that the coal breaks in cubes. It has a resinous lustre.

Closely connected with this coal, above it, and separated from it by some clay shale, we frequently find a calcareous stratum. At some points this is a tolerably pure limestone, of five feet in thickness; but generally it is less, and passes locally into a black calcareous slate, with numerous fossils, or is entirely wanting. Where the limestone is best developed the coal would seem to diminish. The coal rests on clay shales, underneath which, occasionally, more calcareous matter has been observed, mixed with the sandstone, forming a hard calcareous sand rock, or, in the language of the people, a bastard sandstone, or bastard limestone.

The strata over the whole county do not present a regular dip in one direction, but lie in waves, and rise and fall more or less in conformity with the surface configuration of the county. We find them, therefore, again and again, at points where they would have disappeared if the dip presented at other points had not been reversed. I have noticed the same thing in Marion county.

A straight line from Ashley to the Jefferson and Franklin county line, south of Spring Garden, approximately marks the southwestern limit of this coal. Some traces of coal have been discovered farther southwest, especially on Hurricane creek, in the northeast quarter of section 24, township 4, range 1; but I am not positive whether this is the same bed, or a lower seam in the sandstone formation. Northeast of this line the coal has been observed at numerous points, except in the low and flat district on both sides of the Big Muddy and Casey's Fork, south of Mount Vernon, where no rocks have been discovered.

In the northwest corner of the county sandstone is sparingly exposed in the ravines north of the prairie, in section 6, township 1, range 1. It has been struck in digging wells at several points farther south in this prairie, along the county line. The coal has been found in wells near Irvington, about a foot thick. Some miles to the eastward, on the east side of this part of Grand prairie, on Big Muddy river and its branches, the coal and rocks are largely exposed, of which more will be said below. Near the county line, on the upper course of Ray's creek, only occasional outcrops of shales and sandstones were observed—one at the bridge on the Richview and Jefferson City road. Half a mile below that bridge, in the north part of section 8, township 2, range 1, I found in the bank of the creek

some heavy ledges of sandstone, and below them slabs of the impure limestone, over a foot in thickness, partly slaty, partly compact and siliceous. The coal might easily be discovered here, if search were made by digging. The same strata crops out on Cooley branch, in the southwest quarter of section 9, and tumbling pieces of the limestone are found at various points nearer Richview. Sandstones form the banks of Ray's creek at many points farther down, especially in sections 21 and 28 of this township; but still farther down the creek there are no more rocks exposed for several miles; although they may be found by digging to a small depth nearly all over the barreny hills.

At the eastern edge of the prairie, some miles southeast of Ashley, the sandstones and shales, and also the limestone and coal, were observed at various points. Close to the Mount Vernon and Ashley road, at the meeting house in the northeast quarter of section 6, township 3, range 1, sandstone crops out at the head of the ravine. A little lower down are seen blocks of the limestone; then, pieces of black slate, and in the bank, in place, shales with calcareous seams. This is evidently the horizon of the coal bed. One mile farther south, in the northeast quarter of section 7, at Mr. Hunter's, the coal has actually been exposed and dug to some extent, in a ravine at the edge of the prairie, whence it is taken to Ashley and used by blacksmiths in the vicinity. The bed varies in thickness from ten to sixteen inches, is capped by bluish-gray slaty shales, some three feet thick, above which I noticed from four to sixteen inches of limestone. A little lower down the ravine the coal is again exposed with the underlying sandstones; and farther on, in the west part of section 9, the coal is eight or ten inches thick, and the limestone three feet, with two and a half feet of shales intervening between the two. The same strata are found in other branches farther south; but the limestone is quite irregular in its development. At Mr. Green's, also at the edge of the prairie, in the northeast quarter of section 17, the coal is exposed from twelve to sixteen inches thick, with a shale parting, capped by from two to three feet of shale, and then two feet of limestone. Close by, at Mr. Pierce's, the lower part of the coal, a few inches thick, is hard and slaty, of the appearance of an impure cannel coal, but is rather a carbonaceous slate, while the upper part of the seam is rotten. On higher ground, near these points, some sandstone has been noticed, apparently the one above the limestone. Following down the ravine from Mr. Pierce's, we soon find shales, with kidney

ore, and then traces of the limestone and coal, which strata also crop out farther down the creek, in section 16.

Round the south end of Grand prairie, sandstones have been discovered in place at a few points, apparently those below the coal, which latter does not appear to reach very far to the southwest. A sandstone quarry has been worked in section 30, and occasional outcrops are found in section 32, in the southeast quarter of section 33, and more in sections 27 and 26, and in the north part of section 34, between this prairie and Knob prairie.

In the north part of Knob prairie, these sandstones are exposed on a ravine near the Pinckneyville and Mt. Vernon road, near the middle of the north line of section 25, township 3, range 1. It there breaks in thin, hard slabs, in consequence of a false stratification. Hardly a mile farther northeast, the coal and accompanying rocks were again observed on a ravine south of the road, near the middle of section 19, township 3, range 2, and also near the bridge over Ray's creek, in the north part of section 19. On the ravine, the black slate was exposed, with a highly calcareous fossiliferous layer at its base, and at another point, traces of the coal. At the bridge, the bed of the creek is formed of a hard sandstone, or mudstone, with calcareous portions, while the banks consist of shales, with concretions of iron ore. A little below the bridge, the bed-rock changes to an impure siliceous limestone. These strata may underlie the coal, fragments of which are strewn in the creek. A short distance above the bridge, a high bank on the creek shows on top shaly strata, then two feet of the dark-blue laminated slate, then from four to ten inches of the calcareous fossiliferous slate, below that, underneath a parting of shale, two inches of coal and several feet of clay shales. Although the coal is so meagerly developed here, it is undoubtedly the same bed. Three-quarters of a mile higher up the creek, in the northeast quarter of section 24, the bank consists of arenaceous shaly strata, with thin layers of harder sandstone and concretions of iron ore; and some miles farther up, in the southwest quarter of section 1, I noticed, in a high bank, traces of sandstone, of the calcareous slate, and of the impure limestone. These strata were not sufficiently exposed to see the coal, although it must be present. No outcrops occur lower down on Ray's creek, nor on Big Muddy river, from this vicinity south to the county line.

In the south part of Knob prairie, the knob, situated in the southeast corner of section 36, township 3, range 1, is formed of sandstone and arenaceous shales. South of this prairie, between it and

Horse prairie, sandstones and shales are found all over the barrens. They are exposed principally near Buck creek, in the south and east part of section 12, and near Hurricane creek, in the south part of section 13, in the north part of section 24, and east from there, across the range line. At the latter creek, in the northeast corner of section 24, coal is again exposed. At the foot of a sandstone hill we find shales, with concretions of iron ore, below them dark-blue laminated slates, with calcareous portions, and, if I was correctly informed, seven inches of coal. The coal was not exposed at the time of my visit. This is possibly an outcrop of the coal seam so often mentioned before, although it is six miles from the last described and nearest point on Ray's creek, where this coal has been discovered.

On the outskirts of Horse prairie, sandstones, and occasionally shales, are found in wells at various points, especially in sections 30, township 4, range 2, and 35, township 4, range 1, also in the prairie near the range line. Although water is generally obtained there in the Quaternary or Drift deposits, sandstones are found southeast of the town of Winfield, in the northwest quarter of section 32, township 4, range 2, where a quarry has been opened. From Horse prairie, west and northwest, to Little Muddy, sandstones underlie an extensive area, and crop out in the barrens and on the branches at numerous points. They are apparently those between the above named coal seam and the Shoal Creek limestone. Of the latter, and of its probable course across the southwest corner of the county, I have spoken above.

Turning north again, we find the coal variously exposed on the upper course of Big Muddy river, near the eastern arm of Grand prairie east of Irvington and Richview. The sandstone forms prominent layers on every ravine at the edge of the prairie in sections 26, 22, 15, and 16, township 1, range 1. At Mr. Richard Breese's place, in the northeast quarter of section 22, on a ravine below the outcrops of sandstone, the coal has been exposed, and has been wrought to some extent. It is capped by some gray slate, and blocks of hard, impure limestone were also noticed. They were not seen *in situ*, but evidently come from above the coal. The latter is here eight inches thick, of very fair quality, and of the usual appearance of this coal, breaking in square blocks. It has also been found farther west in the prairie, in a well at Mr. Jacob Breese's, in section 21, and farther north, in the adjoining section 15, in the bank of Big Muddy river, at Mr. Hartley's. Here we have, first some fireclay, then two inches of coal, one foot of slaty shales, then from

five to eight inches of good coal, two feet of blue, slaty shale, and above them, gray shales, with some kidney iron ore. A few yards farther on sandstones rise to the surface from below the level of the creek, and consist, in part, of the hard, strongly-cemented calcareous kind.

In the adjoining section (14) the coal has been discovered at several points, especially in the bank of a branch of Big Muddy, at Mr. Thomas Moore's, in the northwest quarter of section 14. The bed of the creek is there formed of the hard sand-rock, and above it follows some clay shale; then the coal, which is from six to eleven inches thick, and of very fair quality; then more shale. Half a mile farther east, in the northeast quarter of section 14, is another outcrop of the coal on a main branch of the creek. It is similar to the last one; but above the shale, which overlies the coal, we have there an irregular layer of the impure limestone, varying in thickness from one inch to two feet. This limestone has been noticed at various points in this vicinity. The coal has also been discovered in the northeast quarter of section 11, near the south line of section 13, and near the southeast corner of section 33. From Mr. Moore's, southward, sandstones are exposed extensively along the banks of the creek for a considerable distance, through section 23, the north part of section 26, and section 25.

At the "Copperas bluff," on the east bank of the creek, near the south line of the southeast quarter of section 25, township 1, range 1, we find an exposure of over twenty feet of shaly strata, with much kidney-iron ore. Upon close examination, we discover, in a little ravine amongst the shales, about twelve inches of coal, of which, however, only six inches appear to be of good quality, the rest slaty; and above the coal the limestone, which is here bluish-gray, slaty, highly fossiliferous, and over fifteen inches thick. It is principally seen tumbling in large blocks out of its original position.

Three-quarters of a mile farther east, on McGinnis' branch, the coal and limestone have also been found, especially in the south part of section 30, and the north part of section 31, township 1, range 2. At the latter place the coal-bed is sixteen inches thick, but has a parting of slate, so that the good coal is not more than ten or twelve inches thick. Underneath it follow twenty inches of shale; then four inches of an impure coal, or rather carbonaceous and argillaceous shales. Above the coal there are also several feet of argillaceous shale. At the other place we find six inches of fine coal at the water-level, and more may be found farther under some of the intervening shales. Above it there are some inches of cal-

careous shale, and then a heavy stratum of the grayish-blue slaty limestone.

At and above the mouth of McGinnis' branch the sandstones capping these strata crop out in the bank of Muddy river, together with the shales and iron ore. They rise northwestward up the stream, so that a little farther on the limestone reaches the surface, and is here two feet or more thick, and hard and siliceous. The coal-bed might be readily found. It has been wrought a short distance south from there, at several points near the village of Jefferson City, situated near the center of section 1, township 2, range 1. On a small branch northeast of the town, in the northeast quarter of section 1, the coal is sixteen inches thick; but only one-half of it is fair, the remainder being slaty. I noticed there, also, some of the limestone. Southeast of the town the upper sandstones are prominently developed at the head of the ravines, and underneath them is found a considerable thickness of shales, and then the coal; but I did not see any traces of the limestone. Nearly two miles farther south, in the northeast quarter of section 13, township 2, range 1, and in the northwest quarter of section 18, township 2, range 2, I observed, on some branches, traces of the limestone, together with sandstone, shales and iron ores, and also signs of the coal, but no good exposures. The sandstone and shales continue in the banks of the creek to Muddy river, and are exposed on that stream above the mouth of the creek, in the northwest quarter of section 17, and again one and a half miles farther down, in the northeast quarter of section 30 (?). This is the last outcrop of rocks on the stream in Jefferson county. Thence southward it has only mud banks.

Near the northeast corner of West Long prairie some sandstone, shales and iron ore were seen in the low banks of a ravine, in the northwest quarter of section 30, township 2, range 2, and similar rocks are occasionally struck in wells in this vicinity; but outcrops of rocks are hardly to be found elsewhere for several miles east and west of Long prairie.

In my report on Marion county I have enumerated various points where this coal-bed has been discovered near the northern rim of Walnut Hill prairie. Near the western and eastern edges of this prairie no exposures of any kind are known in Jefferson county. Only near the south end of it, on the road from Centralia to Mount Vernon, the coal and its accompanying strata have again been noticed on a branch of Little creek, on Mr. William Snow's place, in the southeast quarter of section 17, and for half a mile up the branch, on Mr. John Foster's land, in the southwest quarter of sec-

tion 16, township 1, range 2. The coal presents the same appearance as elsewhere, and is at one point at least fourteen inches thick. With it I observed shaly strata, and the overlying impure limestone, which reaches a thickness of two feet or more. In the prairie, near the center of section 17, Mr. Snow dug a well forty feet deep, through clay and sand, and no rocks are exposed anywhere else on the creeks of this vicinity, except a mile or more farther down the creek, where we find tumbling masses of the limestone and sandstone not far from the road.

Below the southwest end of Jordan prairie sandstone is exposed on a branch near the middle of section 34, township 1, range 2, and more on a ravine at the road near the west line of section 35, where harder layers alternate with more shaly ones. Farther up that ravine, near the edge of the prairie, the coal was again discovered, and the following section of the strata observed: 1st—Shale, forming the bank of the drain. 2d—Coal, from twelve to fifteen inches thick. 3d—A parting of shale, four inches. 4th—Coal, from nine to ten inches thick. 5th—Shales, several feet exposed. Thus we have here from twenty-one to twenty-five inches of coal, of fair quality, while the limestone is either higher above the coal or entirely wanting.

About a mile northeast from this point, near the eastern rim of Jordan prairie, the limestone is so prominently developed that the place is known as "Limestone Branch," while the coal has not been discovered there. It may yet be found, if holes are dug at the proper elevation. This is in the southwest quarter of section 25, township 1, range 2. At the head of the branch some sandstone and shaly arenaceous strata are exposed, and underneath them the limestone, which is gray, has a fine earthy grain, and a few fossils; decomposition gives it a brownish color. It contains much earthy matter, and is apparently five feet thick, and underlaid with shales. It crops out at numerous points over an area of not more than half a mile in width. One mile south of the limestone point, in the southwest quarter of section 36, at Mr. John McMann's, at the edge of the prairie, the coal has been found under four feet of soil, and is reported to have been sixteen inches thick, and of good quality. East of these points, on the Salem and Mount Vernon road, and from there to the east on Casey's Fork of Muddy river, sandstone is prominently developed in the south part of section 35, and in the east part of section 36, township 1, range 2, and southeast from there across the range line; and, in fact, for miles up and

down the valley of Casey's Fork, although, on the banks of that stream, exposures are by no means frequent in this vicinity.

North of the "Limestone Branch" the slaty, fossiliferous limestone, which is a certain indication of the coal, has been noticed, together with shales, near the meeting house on the Salem road, just south of where the road enters Jordan prairie, in the northwest quarter of section 28, township 1, range 2.

In that prairie, at Rome, near the center of section 13, the coal is struck in every well, only ten feet below the surface, and is said to be ten inches thick. At the edge of the prairie, southeast of Rome, the coal has been mined to some extent, especially at Curtis' digging, in the southwest quarter of section 18, township 1, range 3. At that point the bed is fourteen inches thick, of which ten is good coal. I noticed in connection with it some sulphuret of iron; below it, shales, and above it, shales and fossiliferous calcareous slate; and I found sandstone in the vicinity, in the northwest quarter of section 18, and at other points. The coal has likewise been found near the middle of the north line of the northeast quarter of section 24, and farther east, in the southwest quarter of section 17, on John Burnett's land, and in the northwest quarter of section 17, on Benjamin Hawkins' land, a short distance from Casey's Fork. At all these points the coal was from ten to twelve inches thick, and accompanied by shales, the calcareous slate, and sandstone. North of these points, only sandstone has been observed, which is far more prominently exposed than farther south, and appears to be less mixed with shales.

Nearer Mount Vernon, the sandstones and shales may be observed at numerous points, and the coal has been noticed in several places, although few of the outcrops are prominent. Near the southwest corner of section 7, township 2, range 3, at Dr. Maxy's, the coal has been dug some years ago from the bed of a branch. There were twelve inches of good coal, capped by shales. Three-quarters of a mile south from there, in the southeast quarter of section 13, the coal has also been found; and much has been dug still farther south, on another ravine of Miner's branch, at the Union camp ground, in the southeast quarter of section 24, township 2, range 2. At this latter place it is twelve inches thick, of fair quality, contains little sulphuret, and is covered only with soil. Below it, I observed a few inches of shales and sandstone, in thin layers, which latter furnishes good building material. A mile east from this last point, on the lower course of the same branch, in the northeast quarter of section 19, the coal seam measures sixteen inches, of

which two consist of a shaly parting. Above it, there are some inches of a shaly material; then eighteen inches of the fossiliferous calcareous slate, followed by shales, with kidney iron ore. Shales also appear below the coal, while sandstone crops out near by.

Again, one mile farther southeast, at Toll's old mill, a short distance north of Mount Vernon, in the southwest quarter of section 20, township 2, range 3, the bank of the East Fork is formed by some fifteen feet of slaty shales, with much carbonate of iron in sheets or concretions. This is the shale above the coal, which latter lies in the bed of the stream, is twelve or fourteen inches thick, and of inferior quality. Of the calcareous slate, I only noticed loose masses, which appeared to have become detached from the bank. The shales crop out at several other points just above the old mill.

Mount Vernon, the county seat, is situated on the hills west of the East Fork, principally in the southwest quarter of section 29, township 2, range 3, extending into the southeast quarter of section 30. In digging to a depth of twelve or fifteen feet, shales are struck which are generally arenaceous. At a depth of about eighteen feet the coal is found, near twelve inches thick. Water is obtained at depths varying from twelve to twenty feet. It can only be used for household purposes in the wet season. After that time it becomes too highly charged with salts, principally of iron. Cistern water is therefore generally used in town. At the southeastern edge of the town are some remarkable springs of this mineral water, owned by Dr. Wm. Duff Green, of which more will be said below. In the vicinity of the town, shales and tumbling masses of sandstone and limestone are found at several points, indicating the presence of the coal seam.

West and southwest of Mount Vernon, towards Muddy river, there are hardly any exposures of rocks. Sandstones and shales have been found at a few isolated points. East of town, on the East Fork, the only outcrop is near the fair grounds, near the northwest corner of section 33; and at the ford at that point, the bed of the river consists of slaty sandstone, and the bank of argillaceous slaty shale. Besides, I observed so much of the impure limestone in tumbling masses, that I became satisfied that it must be in place a few feet higher, hidden by soil and detritus. A mile farther down, there is another rocky shoal, and just above the bridge, on the Lynchburg road, in the north part of section 9, township 3, range 3, shaly sandstone forms the bed and bank of the stream. This is the last rocky outcrop on the East Fork in this county.

South of Mount Vernon, between the main and east forks of Muddy river, exposures of the strata are few and far between. A mile and a half southeast of the town, on Mr. Jones' place, in the northwest quarter of section 6, the coal has been dug some years ago, from the bottom of a ravine in Town prairie. It appears to have been twelve or fifteen inches thick, and covered directly by the soil. It has also been struck in wells in this vicinity. Two miles due south of town, on the same ravine, close to the edge of the prairie, in the northeast corner of section 7, sandstone crops out and is quarried to some extent for building purposes. It is soft, but hardens in the wall, and the layers are of convenient thickness for ordinary use. Farther south, between Town prairie and Elk prairie, sandstones and arenaceous shales are exposed at numerous points in the barrens, especially in sections 25 and 26, and in the northwest corner of section 36, township 3, range 2. They evidently underlie this timber district at a small depth. Farther south, outcrops are not known.

The northeastern part of the county, east of the East Fork, is also occupied by the same formation, and the sandstones especially are exposed at numerous points; but the coal has also been discovered at various localities. Thus we find it on one of the eastern affluents of the East Fork, in and near the northwest corner of section 4, township 2, range 3, near Mr. Edwin Collins'. The coal has been dug from the bed of the branch; was from twelve to fourteen inches thick, and of very fair quality. The bank above it showed slaty shales, with kidney iron ore, and I noticed, besides, slabs of the calcareous fossiliferous slate and tumbling sandstones. We find coal, again, one and one-quarter miles farther north, on another branch, in the southwest quarter of section 28, township 1, range 3; and near the head of a third, in the southwest quarter of section 9, township 2, range 5, at Mr. Wm. H. Chastiner's. Here four or five inches of it are exposed between sandstones, of which some are hard and calcareous. No slate or limestone were found with it. I believe this last to be the same bed of coal, although it may possibly be distinct. It is said to make its appearance again half a mile farther west, on another branch of the same creek.

On the various branches of Seven-mile creek, sandstones have been observed. The first known outcrops of coal occur just north of the road leading east from Mount Vernon, in the southwest quarter of section 23, township 2, range 3, and in the east part of section 22, near Mr. Robert Grant's place. The slaty shales form the bank of the ravine, with sandy strata above them. The coal which

forms the bed of the ravine was covered up at the time of my visit. On another branch of the creek, two and a half miles farther southeast, at Mr. James Collins', in the southeast quarter of section 36, township 2, range 3, the coal has been dug to some extent. It was there nine inches thick, and covered with six feet of shale. Near by, on a branch in the northeast quarter of section 1, township 3, range 3, it was found seven inches thick, accompanied with sandstone, shales, iron ore, and a thin layer of the slaty limestone. One mile from this point is Lynch's coal bank, in the northeast quarter of section 2, township 3, range 3, where Mr. Collins has dug far more coal than at his own place. It is the same vein, although here from fourteen to sixteen inches thick, and of good quality. On the main Seven-mile creek, the coal is exposed one mile from its mouth, near the center (?) of section 3, township 3, range 3. It is in the lower part of the bank of the creek, and at the time of my visit was covered with water. It appears to be from twelve to sixteen inches thick, of the same general appearance of all this coal, but of rather indifferent quality. The higher portion of the bank consists of shales, and the summit of heavy layers of a fine sandstone.

On Horse creek, in the extreme northeast part of the county, on the waters of Wabash river, the sandstones form the principal exposures. In the southwest quarter of section 7, township 1, range 4, the bank of the creek is formed principally of shaly sandstones. At one point it rises to a height of thirty feet, and consists mainly of slaty shales, with some intercalated sandstone, and twenty-five feet above its base, a seam of coal, capped with black slate. The strata had slipped too much out of place to obtain an accurate measurement. One mile farther south, in the southeast quarter of section 18, on the upland, the same coal has been discovered in digging a well, and near the middle of the east half of section 19, township 1, range 4, on Coal-bank creek, it has been worked to some extent. I observed there, in the bank of the creek, twenty-five feet of slaty and partly arenaceous shales, which in their upper part contain much iron ore, with sandstones following above. The coal has been dug here from the bed of the creek, but is not now exposed. It is said to be from eight to twelve inches thick, and of good quality. I noticed no black slate with it, and only traces of the slaty limestone. The coal extends from this point down the creek to its mouth. It has also been dug in the southeast quarter of section 17, at the water's edge. It is there from fifteen to eighteen inches thick, of very fair quality, firm, and contains little sulphur. Here, too, only traces of the black slate were observed,

besides the shales and sandstones. These diggings on Coal-bank creek are the only places for miles around where coal has been mined. A short distance below the mouth of this creek, at a ford of Horse creek, in the southwest quarter of section 16, its bank consists again of shales, etc., with some six inches of coal. I am not certain whether this is the same vein as the one described last, or whether the latter does not lie underneath the bed of the stream, separated from the outcropping one by some intervening strata of rock. Down Horse creek we find sandstones and shales at a ford in the east part of section 21, and twenty-five feet of sandstone at Haynie's old mill, in the southeast quarter of section 27, and more still further in the hills. The prominent hills on the south side of the creek, west of the Wayne county line, in the north part of section 1, township 2, range 4, are capped by sandstone, underneath which follows a hard and dark-gray slate, which changes imperceptibly to a slaty limestone, some of which is very hard. Below that, shales seem to follow, and traces of coal have been discovered. This is apparently the same horizon of our coal seam. Some of the limestone closely resembles a similar rock found near the coal east of Lynchburg, in this county, and the same has been noticed in the extreme northeast of the county, near 'Squire Wells', in and near the southwest quarter of section 2, township 1, range 4, where it is found tumbling on the hillside, while the summit is likewise formed by sandstone.

Near Farington, and along Puncheon Camp creek, and on Four-mile creek, on the north side of East Long prairie, throughout township 2, range 4, sandstones alone have been observed, with the single exception, as far as I could learn, of one point on the county line, near the middle of the east line of section 13, north of the Mount Vernon and Fairfield road, near Mr. Joseph Henry's, where the slaty limestone makes its appearance.

In the southwestern part of the county, the sandstones are not so prominently exposed, owing, perhaps, to the less broken character of the country; but together with the shales, the coal seam, and the slaty, calcareous stratum, they have been found at numerous points. I have stated above, that on the East, or Casey's fork of Muddy river, no rocks have been discovered in this county below the bridge on the Mount Vernon and Lynchburg road; nor are there any in the low and flat district between the East Fork and the Spring Garden road. Some sandstone was observed on that road, half a mile from the bridge, in the southeast quarter of section 9, township 3, range 3, and the coal has been found in digging a well on a ravine

near Mr. Mills', near the south line of section 10, on the Morse prairie road, only three or four feet under ground. It is said to have been fifteen inches thick, and of good quality. A mile southeast from there, where the road crosses Dodd's creek, we find a high exposure of slaty shales, much the same as at Toli's mill, near Mount Vernon, and apparently a continuation of the same strata, while sandstone is in the upper part of the hills, and continues all along up Dodd's creek, through sections 13, 14, etc.

Near the head of one of the branches of the creek, in the southeast quarter of section 13, township 3, range 3, is Warren's coal-bank, which, though differing much from other outcrops of our coal seam, cannot be regarded as a different one, but merely as a local variation. Gray slaty shales crop out there in the hillside, and below them, the coal. It is at least twelve, perhaps sixteen inches thick, and breaks in cubes which readily split horizontally, while the cross-fracture is conchoidal. It has the appearance of cannel coal. Underneath it, is some fire-clay, and then, hard sand-rock; while sandstones appear to form the summit of the hill.

Sandstones and shales underlie the upland between Dodd's and Atchison creeks, and have been found in section 27; but outcrops are scarce, except on some branches of Atchison creek, near a spur of Morse prairie, in the south part of section 1, and the northwest quarter of section 12, township 4, range 3, and in section 6, township 4, range 4, where we have the same strata as on Dodd's creek. The coal has been discovered on this creek, in Morse prairie, on Mr. John W. Miller's place, in the northwest quarter of section 5, township 4, range 4, where it is said to be twelve inches thick, and covered only with three feet of soil, but has not been much opened.

The next creek south is Gun Prairie creek, which runs all along between mud banks. The principal exposures of rocks on its branches are some sandstone in the southwest quarter of section 13, township 4, range 3, and near the edge of Morse prairie, in the southwest quarter of section 20, and the northwest quarter of section 29, township 4, range 4. At the town of Spring Garden, in Gun prairie, water is obtained by digging down from ten to twenty feet deep, partly in the Quaternary, partly in shales. At the Spring Garden mill, one mile and a half south of the town, the coal is exposed in a high bank on a branch of the creek, in the southwest quarter of section 26, township 4, range 3. It is from twelve to fourteen inches thick, rests on fire-clay, and is capped by a little slate, and then eighteen or more inches of the fossiliferous, calcareous slate, covered by soil. Higher in the hill, sandstone has been found. The coal

contains here some sulphuret of iron. Half a mile farther south, in the middle of the west half of section 35, the coal has again been found on a ravine.

Lynchburg is situated at the northern edge of Morse prairie, in the southeast corner of the southwest quarter of section 5, township 3, range 4. In the vicinity of the town sandstone and shales are struck in digging wells, at a small depth, and, a little deeper, the coal. A mile and a half east of the town, on Auxier creek and its branches, are several coal diggings of much local reputation. First, we come to Wilkeson's, close to the edge of the prairie, on a small branch, in the southeast quarter of section 4, township 3, range 4. We noticed there in the bank a few feet of shales, which inclose kidney-ore. From underneath these the coal was formerly dug, but is not now to be seen. A short distance up the branch we find in its bed an outcrop of the dark bluish-gray, hard and partly slaty limestone, apparently twelve inches thick, the same which was observed at various points farther north, and which, in other localities, is represented by the calcareous slate, so rich in fossil remains. On another branch, close by, this limestone is again exposed, capped with some slaty strata and sandstone.

The next is Shelton's coal-digging, on the main creek, just north of the road, in the southwest quarter of section 3, which supplies the country for miles around with its blacksmith coal. The bed, which consists of sixteen or eighteen inches of good coal, lies just underneath the creek level. In the bank, above the coal, are some feet of slaty shales, with iron ore. In breaking, the coal follows the horizontal and vertical partings, and forms fine solid cubes of considerable firmness and luster, which exhibit well the alternation of more or less shining layers. It contains little sulphur, but the partings are brown, from oxid of iron, produced by the decomposition of sulphuret of iron, which probably remains undecomposed in portions of the stratum farther removed from the outcrops. Next, we find the coal just south of the road; and a little farther, in the extreme northwest corner of section 10, at widow Jordan's, the coal and the shaly strata underneath it, rise above the level of the creek. The coal here is thirteen or fourteen inches thick, and at another point, from eighteen to twenty inches, and of the same quality as at the former place—except that I noticed with it some lumps of sulphuret of iron. The next point at which the coal has been discovered, is one mile farther south, on much higher ground, on a branch of the creek at the edge of the prairie, at Mr. Reese's, in the southeast quarter of section 9. It has been dug there to some

extent. Its quality is similar to Shelton's. Above it, I noticed traces of the limestone in the form of a calcareous slate. Below it, a considerable thickness of sandstone is exposed, which continues on the branch to the creek. One mile farther southwest, in the middle of the east half of section 17, the coal has been found on a ravine in the prairie, on Mr. J. C. Jones' field; and near the southeast corner of the section, layers of a hard, thinly-stratified and partly ripple-marked sandstone, (which has frequently been mistaken for limestone), crop out on another ravine of Rocky branch, along which sandstones, and lower down also shales, continue across the south part of section 16, and the southwest quarter of section 15, township 3, range 4, to Auxier creek. On the latter, in the northwest quarter of section 22, the bank consists of arenaceous and shaly strata, and some coal has been found above them in the bank. It is not now exposed, but loose fragments of it may be seen. I could not learn particulars in regard to it. Thence, down Auxier creek, to the county line, sandstones are occasionally found in the edge of the low bluffs on the south side. On its north side rocks are unknown for some distance.

The coal was next observed four miles farther south, on Stone-coal branch of Shelton Fork, at Mr. Edward Price's place, on the Mount Vernon and McLeansboro road, in the northeast quarter of section 10, township 4, range 4. It is in the bed of the branch, and not opened at present, but has formerly been worked to some extent. It appears to be from sixteen to eighteen inches thick, and underlaid with sandstone, part of which is thinly stratified and shaly; the rest firmly cemented and exceedingly hard. The water in this vicinity is at some points highly impregnated with salts, especially salts of iron, originating from the decomposition of the sulphuret of iron of the coal-bank. The coal has also been found in a well at Mr. Shipley's, in the northeast corner of section 2, farther down on this branch.

The next prominent exposure of coal is two and a half miles southeast of Price's, east of Wilbank, on another branch of Shelton Fork, just below the edge of the prairie, in the northwest quarter of section 24, and reaching into section 23. It is known as Bowen's coal-bank. A considerable quantity of coal has been obtained there by the blacksmiths of the vicinity. It is eighteen inches thick, and of fair quality. At some points it is directly covered with soil; at others, with blue slates. No trace of the limestone was noticed. Above and below the diggings sandstones crop out on the branch, and they form prominent bluffs along it in the northeast quarter of

section 23, and in the east part of section 14, close to the edge of the high prairie, and even farther down in the southwest quarter of section 12. Half a mile southwest of Bowen's coal-bank the coal has also been discovered on a prairie ravine, on McPherson's old place, in the southeast quarter of section 23.

In the extreme southeast corner of the county, south of Morse prairie, the coal is exposed on branches of Sugar-camp creek, at Roundtree's mill, in the northeast quarter of section 35, and at Dr. Wilkey's, near the middle of the west line of section 36, township 4, range 4. At the former place the coal crops out just above the bed of the branch, and is from nineteen to twenty inches thick, with partings of shale, otherwise of very fair quality. Above it, I measured ten inches of slates; then, one foot of sandstone and six feet of gray slaty shales. Higher in the hill are sandstones. Farther down the branch, these sandstones dip to the water level. Across the hill, at Dr. Wilkey's, the coal is principally dug in the creek bottom, from underneath the alluvium, but may also be seen in the side of the bluff, underneath other strata. It is nineteen inches thick, and contains much sulphuret of iron. Above it, we see arenaceous and slaty shales, and over two and a half feet of the characteristic calcareous slate, with its numerous fossils. This rock was wanting at Roundtree's, on the other side of the hill. We see from this example how variably this calcareous stratum is developed, and that although its presence may be regarded as a proof of the identity of different outcrops of the coal, its absence is no proof of non-identity.

I have been informed that one and a half miles east of the corner of this county, in Hamilton county, at the southeastern edge of Morse prairie, at Mr. Chester Judd's, the limestone has been again found, in connection with the coal, in place of the calcareous slate. Round the southern edge of Morse prairie, from Wilbank west to Gun-prairie creek, and also on branches of Sugar-camp creek, near the Franklin county line, sandstones are found at some points rather prominently developed, especially in the northeast quarter of section 33. There are also some shales exposed, but the coal has thus far escaped observation in this district.

Economical Geology.

Coal.—The perusal of the foregoing description of all the noteworthy discoveries in the county, leads us to the inevitable conclusion that all the coal which is near the surface in the county, with the exception of that in the southwest corner, belongs to one stratum,

which is in some places divided in two by a parting of shale, and which is the same that extends all over the adjoining county of Marion. The stratum at a few points exceeds one and a half feet in thickness, of good coal, and is frequently thinner. Where it is thicker, it generally contains impure portions. It is at many points of a very good quality, and, as the country is broken, it can be profitably worked in numerous localities by stripping along the outcropping edges. It is therefore well adapted to supply the local demand for coal throughout the county, at a very moderate cost. In the introductory remarks, I have already stated that the coal and accompanying strata are neither horizontal nor dipping in one direction, but that they form waves which follow more or less the surface configuration of the country.

Now the question arises, whether there is a lower coal bed of greater thickness, at an available depth. The next lower coal seam is that underneath the Shoal Creek limestone; but we have seen that this coal, where it is known on Little Muddy river, near the west line of the county, is too thin to pay the expenses of deep mining. This seam may become of some local importance in the southwest corner of the county, where it can be worked by stripping along its outcrops on a limited area; but, farther on, it is covered by a considerable thickness of the higher strata. The only remaining coal bed of good promise is, then, the one which is worked in the coal-shaft at Tamaroa, on the Illinois Central railroad, at a depth of about two hundred feet below the surface, which is the DuQuoin coal. Tamaroa is a little over four miles west of the southwest corner of the county; and it would therefore seem as if this coal bed, in the nearest part of the county, could not be much, if any, deeper. I do not think so, however. My knowledge of these same formations in the adjoining counties leads me to the opinion that this coal dips rapidly downward from Tamaroa, and in most parts of Jefferson county lies at a considerable depth.

It may be expected to be found at the least depth in the southwest corner of the county; but even there it would hardly be reached before going down several hundred feet.

The coal vein near the surface at Central City is the same as the one near the surface in this county. I refer to what I have said on the subject in the above mentioned report. If a great demand for coal should arise, I think this lower coal bed might supply it. Its depth, at least, would not be greater than that of many coal-pits in other countries, and the only question would be as to its

thickness, of which we can now only say that at Tamaroa it amounts to five feet eight inches.

Minerals.—The shales accompanying the coal bed contain generally much kidney-iron ore—an impure carbonate of iron, in sub-globular concretions, or in flat bodies or sheets. The aggregate quantity of this ore is large, but it is probably not concentrated at any one point in sufficient quantity and of sufficient purity to be for the present of practical value for the production of iron. Some pieces of galena have been found scattered over the country, such as occur in the drift in many other counties of our State.

Mineral Waters.—The water in some parts of the county is impregnated with salts, originating principally from the decomposition of the sulphuret of iron contained in the coal or shales, and from the action of the sulphate of iron thus produced upon the strata which it percolates. Thus other and more complex combinations of salts are formed, such as magnesia salts, alums, etc. As the coal seam is near the surface in many neighborhoods, wells are frequently sunk down to it or to the accompanying strata, and this well-water contains these salts in variable quantities, which are often sufficiently large to prevent the use of the water for household purposes. Thus we find it, for example, at Mount Vernon, at Rome, in some parts of Morse prairie, especially at the Stone-coal branch, and at other places.

The strongest mineral water which has come to my notice in the county is from the springs of Dr. William Duff Green, at the south-eastern edge of the town of Mount Vernon. There are several of them. They issue from the side of a shallow ravine, at the same level, a few feet from each other, from a highly ferruginous stratum, which is apparently the slaty shale, with the iron ore above the coal seam here changed beyond recognition by the long-continued influence of the mineral water. These springs all contain a considerable quantity of iron, combined with other salts. It is remarkable that the water of all of them is not quite the same. The difference consists, however, principally in the relative quantity of the salts. The springs evidently emanate from the same stratum; but, passing through different portions of the rock, the water may come in contact with slightly different mineral substances.

The temperature of the running springs is the mean temperature of the earth in this latitude, or, what is the same, that of a deep, cool cellar; but one spring, which is by Dr. Green called "Tepid Spring," differs from the others in various respects. It is warmer

than the others, at least in summer, because, not running as freely as they do, its water is stationary, and assumes the temperature of the air. It is said not to freeze in winter, which is apparently not a consequence of intrinsic heat, but of its saline character. Its water has a milky hue, because the iron salts which it contains begin to decompose in the orifice of the spring, where they are long exposed to the oxydizing influence of the air, without being discharged. Such is the simple explanation, based on the teachings of science, of some facts which have been regarded as wonderful mysteries. Nature's works seem mysterious, but all conform to definite laws, which, when the principles are once understood, appear plain and clear as daylight. A small quantity of gas is evolved in the springs, either through the action of the sulphates upon carbonates in the strata, or perhaps altogether by a vegetation of a low order, which rapidly grows and coats the orifice of the springs, and, under the direct action of the sun's rays, exhales oxygen.

Although originally similar, the waters of these different springs very probably have a different medicinal effect upon the system.

Building Materials.—Sandstone for foundations, the walling of wells, and for all ordinary and heavy masonry, can be readily obtained in nearly all parts of the county. Good quarries are already known in large numbers, and with little labor many new ones might be opened in convenient locations, as sandstones form the principal substrata of the county.

The limestone, the different localities of which have been enumerated in the above report, is generally impure, siliceous or argillaceous. At some points it can, however, be burnt and used for making mortar, which has been done in former years. If the demand was sufficient, better quarries might be opened, and a better article might be obtained. At the present time most of the lime is shipped from a distance.

The fossiliferous slaty limestone, or calcareous slate, is undoubtedly a superior fertilizer, but has not yet been used as such. Its wide distribution over the county will render it valuable in future times.

Brick may be manufactured wherever needed; and of fine timber of various kinds, white oak, black oak, post oak, black walnut, etc., there is an excellent supply.

Agriculture.—The soils of this county are similar to those of the adjoining (Washington) county, especially in its western portion, where the same geological formation prevails. I may refer to what I have stated in my report of that county. The white under-clay,

which is such an unwelcome feature of some of the prairies along the Ohio and Mississippi Railroad, hardly anywhere extends into Jefferson county. This is a decided advantage to the fertility of the county, which is naturally great. The post oak flats, too, are not so extensive, and are of the better class.

The land outside of the prairies is generally more rolling, covered with a varied growth of timber, and is all well adapted to the cultivation of grain and all sorts of fruit. Some portions of the county are still thinly populated, but the advantages which the settler finds will necessarily soon attract a large and industrious population to its fertile hills and broad prairies.

CHAPTER IX.

COOK COUNTY.

BY HENRY M. BANNISTER.

Cook county is bounded on the north by Lake county, by Lake Michigan and the State of Indiana on the east, by Will county on the south, and on the west by Kane and DuPage counties. It embraces a superficial area of nearly twenty-five townships, or about eight hundred and ninety square miles. It is of an irregular shape, the main body extending north and south along the shore of Lake Michigan, but having at its northern extremity an area projecting westward, including townships 41 and 42, in ranges 9, 10 and 11 east of the third principal meridian. That portion of township 37, range 11, lying south of the Des Plaines river, forms another less extensive westerly projection.

The principal streams in this county are the Des Plaines, which traverses it in a general north and south direction, and the Chicago and Calumet rivers, emptying into Lake Michigan. These, with their tributaries, and one or two minor streams in the northwestern part, emptying into Fox river, drain every portion of the county.

The proportion of prairie to wooded land in this county is a little greater than two to one. The timber is distributed in belts, of varying width, along the water-courses and on the shore of the lake, with frequent groves or timber islands in the open prairie. In many places, however, much of the original forest has been cleared away, and the process of denudation of timber is still going on.

The surface of the country is generally level or gently undulating, the latter character prevailing in the northern and southwestern portions of the county, becoming more broken and even hilly in the extreme northwestern and southwestern parts. The hollows between

the undulations are often marshy, and occasionally contain deposits of peat of greater or less extent. The central and southeastern portions of the county are mostly level, consisting of nearly flat, and in some cases marshy, prairies, with occasional groves and belts of timber.

The soil of the prairies is usually a black or dark brown mould, varying from one to four feet in depth, and is underlaid by a lighter colored sandy or gravelly clay sub-soil. In the dry timbered tracts this sub-soil comes very nearly to the surface, and generally throughout the county supports a growth of black, white and red oak, butternut, black walnut, bitternut and shell-bark hickory, cottonwood, etc., with an undergrowth chiefly of hazel. In the damp woodlands of the central portions of the county, we find, in addition to the above species, bur oak, elm, black ash, and locally sassafras, forming a considerable proportion of the timber. On the sandy ridges which skirt the shores of Lake Michigan, the timber is almost entirely composed of the different species of oak, black, white, yellow, red and bur, with an occasional clump of red cedar or white pine, with cottonwood on the edges of the narrow sloughs which separate the ridges. The soil of these ridges is probably the poorest for agricultural purposes in the county, for, though warm and quick, it is light and easily exhausted, and from its sandy nature is most quickly effected by drought.

The surface deposits in Cook county consist of the drift proper and subsequent alluvial and lacustrine deposits. The former, consisting of blue clay and hard-pan, becoming locally brown and yellow, with numerous boulders, covers most portions of the county to the depth of from ten to eighty feet, or even more, and is overlaid at various points by the more recent lacustrine deposits of the Terrace epoch. Of the more ancient geological formations, we find in this county only the outcrops of the limestones of the Niagara group, which attains here, as well as we can estimate, a thickness of nearly three hundred feet.

Surface Geology.

It is evident, with very little observation, that at a comparatively recent period, subsequent to the Glacial epoch, a considerable portion of Cook county was under the waters of Lake Michigan, which at that time found an outlet into the Mississippi Valley through the present channel of the Des Plaines. The deposits of this period consist of beds of stratified sand and gravel in the central and

eastern portions of the county, either underlying the flat prairies or arranged in the form of ridges, skirting the shores of the lake, and in one or two cases trending westward away from it to a distance of several miles. One of these ridges, which runs in a general east and west direction, is well seen on the road between Thornton station and the village of Old Thornton, in the southern portion of the county. It extends through the whole southern tier of sections in township 36, ranges 14 and 15 east, beyond the limits of the county and State, crossing the State line at Lansing station, on the Chicago and Great Eastern Railroad. Another westward spur from the lake ridge is seen on the road running westward from the village of Grosse Point, in the southern tier of sections, town 41, ranges 12 and 13 east. Still other sand ridges may be observed running in a general north and south direction, but at a distance of even seven and nine miles from Lake Michigan. These latter are not generally very prominent, and are better recognized by the change in the nature of the soil and vegetation than by their elevation above the surrounding surface. The westernmost of these passes through the village of Oak Ridge, and running in a direction west of south, crosses the Chicago, Burlington and Quincy Railroad a few rods west of the depot at Lyons, and is lost in the slightly rolling country, after crossing the Des Plaines river.

These ridges seem to me to indicate the shores of the ancient bay, which, with these boundaries, would require the level of Lake Michigan to be nearly forty feet higher than at the present time. The outlet was evidently near the summit, where the Illinois and Michigan canal passes, and where at the present time an alteration of the level for a very few feet would send the waters of the Chicago river into the Des Plaines. Another very evident outlet, to the south of this, was through the channel now utilized by the Calumet feeder, joining the Des Plaines at the Sag, about four miles north of Athens village. The mound, or ridge, at Blue Island may probably be referred to this level of the waters. The evidences of a powerful stream are numerous on the rocks at Athens, in the shape of water-worn surfaces, pot-holes, etc. The nearer ridges, running parallel to the present coast line, would appear to indicate a very gradual recession of the waters of the lake, before reaching its present limits.

The structure of these ridges is similar to that of beach deposits, generally consisting of irregularly stratified sand and gravel beds, with sometimes a thin seam of vegetable mould. This structure is well displayed on the lake shore, north of the University grove, at Evanston, where the wearing action of the lake storms upon the

shore has cut down one of the ridges upon which the town is built. The following section, with which I am favored by Prof. MARCY, of that place, was taken with great care, and is of especial interest as showing evidences of changes in the relative levels of land and water during this period:

1.	Surface soil	1½ feet.
2.	Fine sand	2½ "
3.	Coarse sand	2½ "
4.	Fine sand	2 "
5.	Gravel	1⅓ "
6.	Fine sand, containing tree trunks, etc	1½ "
7.	Dark colored marly bed, the lower part peaty	1½ "
8.	Fine sand	3¼ "
9.	Blue clay	3½ "

In addition to the beds given in this section, there may be seen at one or two points a thin seam of vegetable mould, resting immediately on the blue clays of the drift, and at the base of the true lacustrine deposits. In this seam there have been found many pieces of small wood and stems of small trees, apparently cedar, and, in one instance at least, the stump with the roots penetrating the clay below to a depth of two or three feet, evidently in the position of its natural growth, thus showing that the land was at that time sufficiently elevated to support trees. Water-worn pieces of wood, apparently cedar, are quite frequent in the stratum of sand above the clay, (No. 8 of the section).

The bed No. 7 of the section, may be followed for upward of half a mile along the beach, and is also frequently met with in digging wells in the town. An occasional fragment of bone, and a great abundance of fossil fresh-water shells are found in this bed. The shells are all of existing species of *Unio*, *Pisidium*, *Physa*, *Lymnea*, *Planorbis*, *Valvata*, *Amnicola*, *Melontho*, *Ancylus*, etc. Immediately above this bed, and generally resting upon it, in the stratum of sand No. 6, we find many stems of large trees, chiefly oak, which seem to have drifted to their present resting place as the waters of the lake gradually encroached upon the marsh.

In the eastern part of the county, along the lake shore, we often find the black surface soil of the small wet prairies underlaid by a bed of quick-sand, containing fresh-water shells of the genera *Melania*, *Unio*, etc., which belong to the same period as the lake ridges. Instances of this kind of prairie may be observed along the lines of most of the railroads running southwestwardly from Chicago, and on the Milwaukee railroad running north. Indeed, such prairies may be seen at the present time, in the process of formation, at various points along the lake shore in this county and elsewhere.

The bed No. 7 of the section was probably deposited under conditions very similar to those of the formation of these prairies, in the bottom of a shallow lagoon or marsh, and serves to show how gradual was the process of submergence or emergence, during which it was formed.

The ridges, which are cut off by the lake, strike the shore at a small angle, and from their direction we are able to judge of the trend of the coast in former times, and it appears that a large territory, probably many square miles in extent, has been washed away by the wearing action of the lake waves. At the present rate of wear, which at the greatest estimate, and at the most exposed points, is but a very few feet annually, it must have taken many hundreds and even thousands of years to wear away this territory, the lake being at or very near its present level.

The deposits of the drift in this county consist, as has been already stated, of blue clays, becoming locally brown and yellow, and hardpan containing frequent boulders, with now and then a thin seam or irregular stratum of sand or gravel. They probably at one time covered the country to a much more uniform depth than at present, but subsequent eroding agencies have so modified the surface that it now ranges from twenty to eighty or a hundred feet in thickness in different parts of the county. Outside of the city of Chicago we have hardly any data for ascertaining the exact thickness of this formation, as wells seldom penetrate it to any considerable depth, and there is rarely any journal or record kept of the digging. It is probably thinnest west and south of Chicago, as the rocks appear to be nearest the surface in those directions. In boring the artesian well at the Union stock yards, south of the city, it was found to be only about forty-five feet in thickness, and at the rolling mills in the northern part of the city, seventy-six feet of the clays of this formation were passed through. At Athens and vicinity the bluffs will average near eighty feet, or even more, above the uppermost exposures of the Niagara limestone, which is probably not far from the real thickness of the drift in that region. In the northern part of the county, though wells have been dug forty, fifty, and even seventy feet, I am not aware that any have passed through the drift to the formation below.

In the upper part of the drift there is often an appearance of stratification, especially in the vicinity of the larger streams. In the northwestern part of the county, in townships 41 and 42, range 9 east, lying near the Fox river, a very noticeable feature is a stratum of water-worn boulders and pebbles, chiefly of limestone, but with

an occasional hard-head (boulder) of granite, hornblende rock, etc., which crop out on nearly all the hillsides, in some places strongly resembling a natural outcrop of a limestone bed. In the clays and hard-pan of the older drift we often find in this county the finer and more homogeneous stratum in the upper portion. In the section afforded by the shaft of the Chicago lake tunnel, after passing through the more recent beds of stratified sand and gravel, we find some thirty feet of fine blue clay, underlaid by what is described as "greenish hard-pan," containing numerous boulders and angular fragments of rock. The same arrangement of finer clays, underlaid by coarser hard-pan, is to be seen in various sections afforded by the lake-shore bluffs, at and near Winnetka, in the northern part of the county, but the line of division between the two is not generally very distinct.

An interesting feature, which has been noticed by Dr. ANDREWS, in the *American Journal of Science*, and by Dr. JEWELL, in his report to the Chicago Academy of Sciences, on the Lake Tunnel, is the presence of pockets, or irregular beds of sand and gravel, sometimes stratified, occurring here and there, without any regularity, in the clays and hard-pan of the drift. These masses of gravel and sand were accounted for as having been taken up from beach or bar deposits, while in a frozen state, by moving bodies of ice, during the Glacial epoch, and deposited in their present resting places with the finer sediments which formed the clay. However, as these gravel beds form the channels by which water traverses the otherwise almost impervious clays, it is possible that, in some cases, they may be due to its action, or, at least, have been considerably modified by this agency.

With the exception of such as may be found in fragments of rock derived from the older formations, these lower clays, in this county, appear to be almost entirely destitute of organic remains. In one or two instances only has there been observed what appeared to be fragments of decayed wood.

Scratches, such as are usually referred to glacial action, occur on the surface of the underlying rocks, at several places in this county. I have observed them on the limestone beds in the vicinity of Blue Island, and at the village of Old Thornton, on pieces of the rock which had been quarried out. In the former place their direction was due north and south (magnetic), and at the latter, as nearly as could be learned of the position of the pieces *in situ*, from north by northeast to south by southwest. In most places, however, the exposures of rock are not such as will show the striæ well.

Some peculiar surface-markings, which are found on some of the upper layers in the Athens quarries, are deserving of mention here. They consist of parallel grooves, sometimes extending over a considerable surface, and generally trending in a direction parallel to the course of the river (DesPlaines) valley, from northeast to southwest. They have been enlarged by the action of running water, and are very irregular in their outline. These have been referred to glacier action, which, however, seems hardly probable, when their position in the bottom of the river valley is considered. It seems to me more probable that the river channel and bottom have been excavated subsequent to the Drift epoch proper.

Although, as has been already stated, only the limestones of the Niagara group appear in the surface outcrops in this county, we yet have a complete section of the underlying rocks, afforded by the artesian wells which have been bored in the city of Chicago and its immediate vicinity. Of these, the deepest, and in some other respects the most satisfactory for geological information, is the boring at the Union Stock Yards, southwest of the city, which passes through all the strata from the upper portion of the Niagara group to the lower magnesian limestone. The record was kept by Mr. Johnston Ross, who superintended the boring. The whole depth penetrated was eleven hundred and five feet, and after about forty-six feet of drift and surface deposits, the strata were passed through in the following order:

Niagara Group—254 feet.

1.	Bluish-gray limestone	16 feet
2.	Light-gray limestone, slightly varying in shade of color at different depths	138 "
3.	Limestone—nearly white	20 "
4.	Limestone—buff or drab	80 "

Cincinnati Group—250 feet.

5.	Shale—soft and fine	104 feet
6.	Limestone—light-gray	20 "
7.	Shale—coarser and arenaceous	126 "

Trenton Group—330 feet.

8.	Brownish ferruginous limestone	25 feet
9.	Grayish limestone—more or less dark	305 "

St. Peters.

10.	Whitish-brown sandstone	155 feet

Lower Magnesian Limestone—70 feet.

11.	Light-colored limestone—very hard	60 feet
12.	Gray limestone	10 "

The strata are most probably horizontal, or nearly so, and the section, therefore, gives very nearly the true thickness of each bed. The thickness here given of the Cincinnati group, two hundred and fifty feet, is greater than is generally allowed, but this, perhaps, is only a local difference.

Niagara Group.—This formation, as far as can be ascertained from the outcrops of rock, underlies the whole surface of the county. In the northern part, however, exposures of rock are scarcely met with; indeed, all of the outcrops in the county, with, perhaps, one exception, are included in that portion lying south of the north line of township 39, ranges 12, 13 and 14 east. To the northward of this limit the country is covered with a heavy deposit of drift; but this is, in all probability, underlaid by the same beds of Niagara limestone as farther south. The nearest outcrops in the adjoining counties are of that age.

We find the study of the Niagara group, as it is developed in this county, somewhat difficult, not only on account of the infrequency of exposures, but also because of the lack of good natural sections. By means of the artesian well section, however, we learn that its thickness in the vicinity of Chicago is not far from two hundred and fifty feet. There are also certain strata occurring in the southern and southeastern portions of the county, which do not appear to have been passed through by the Chicago borings, and which are probably still higher in the formation. Add from thirty to fifty feet for the thickness of these to the amount afforded by the artificial section, and we have an aggregate thickness of this group in the county of from two hundred and eighty to three hundred feet. The exposed thickness, however, is somewhat less, as the lowermost beds do not come to the surface within the limits of the county. The dip of the strata appears to be mainly to the south and east, thus bringing the uppermost beds to the surface in the southern and eastern portions of the county. The principal outcrops, commencing at the (supposed) upper beds, are as follows:

About a mile and a half east of Bloom village, near the line of the Joliet cut-off of the Michigan Central railroad, in the southwest quarter of section 22, township 35 north, range 14 east, there occurs an outcrop of these strata in the bottom and sides of a small stream. The exposure is only of about six feet, of a light-gray, fossiliferous limestone, weathering to a yellow or buff color, of a decidedly concretionary structure, and showing stratification very imperfectly. The rock is in many places stained with bitumen, and contains cavities filled with this substance in a semi-liquid condition,

though, in the rock itself, the more volatile part appears to have mostly evaporated, leaving only a black stain, or in some instances particles of dark, coaly-appearing matter. The outcrop appears to be on a ledge or upheaval, which extends for nearly two miles in a general northeast and southwest direction, having a breadth of from a quarter to half a mile. The rock is exposed, however, at but a few points, being elsewhere covered with soil to the depth of a foot or more. The most southerly outcrop lies about a quarter of a mile south of the railroad, and is of very limited extent.

Somewhat more than a mile northeast of the first-mentioned locality, in the northwest part of section 23, at Miller's lime-kiln, the same beds are quarried for lime, and present a precisely similar appearance. The bituminous character of the rock is evidenced by a very perceptible odor during the process of burning the stone in the kiln. Just north of the kiln, at the bottom of one of the excavations, there appears an impure buff-colored stratum, with a little of a bluish tinge where it is least weathered, and having somewhat the appearance of a hydraulic rock. The exposure, however, is too limited for a thorough examination, and nothing could be learned of any practical test as to its qualities, excepting the statement that it would not slack after burning in the kiln.

Immediately north of this locality the ledge disappears under the drift, and no exposures of rock are met with within several miles of this point. The nearest occurs in the southeast quarter of section 4, in the same township, where the bed of Thorn creek, for a few feet, is composed of an impure bluish limestone, containing what are apparently traces of fucoids.

In the quarries at Old Thornton, the strata have a strong dip, varying from ten to twenty degrees, to the southeast, and by this a considerable thickness of the strata is exposed. The exposures, however, are not continuous, and it is not easy to ascertain the exact amount, but perhaps about seventy-five feet will be a sufficiently low estimate. The uppermost beds exposed here, appear on the west bank of Thorn creek, about two hundred yards above the bridge, and are probably equivalent to the beds exposed at Miller's, though differing somewhat, lithologically. The rock is a massive gray limestone, rather dark in color, and more compact than the rock in the above mentioned locality, but like it in being highly fossiliferous, and bearing identical species of *Pentamerus*, *Favosites*, etc. In the quarries nearest the bridge, the rock is a yellowish limestone, showing a light gray color on freshly-fractured surfaces, and, with the exception of silicified corals, the cavities of which are frequently

filled with bitumen, apparently destitute of fossils. From the direction of the dip at these two exposures, about south 40° east, it is evident that there is a considerable thickness of intermediate strata which is not exposed.

In the quarries in the village, the rock is similar to that at the bridge, the lowest beds, perhaps, rather darker colored, but are much fuller of traces of organisms, though well preserved fossils are not abundant. Bitumen stains are abundant throughout the rock, and masses of this mineral, in color and consistency resembling cold pitch, are occasionally met with. At Leavitt's quarry, the easternmost of the excavations at this point, the rock changes to a blue, or bluish gray, impure limestone, probably identical with that before mentioned as occurring in the bed of Thorn creek, in section 4, township 35, range 14. When weathered, its color changes to buff, the change not limited to the surface, as in ordinary cases of weathering, but extending inward, often for two or three inches or more, according to the length of time that it has been exposed. About ten feet of this bed is exposed in the quarry. It is underlaid by strata similar to those worked in the excavations to the west, which are also beneath it in position. It is probably intermediate between them and the gray fossiliferous limestone, which outcrops on the creek a little farther east. In the lower part of this bed, near its junction with the strata beneath, we find many fine silicified corals, such as *Favosites*, etc.

Throughout the village, and for a mile or more in the directions north and northwest, the rocks appears to be very near the surface, covered for the most part with only a thin stratum of surface soil. The finer materials of the drift deposits, which once covered this tract, have been washed away, leaving the surface strewn here and there with the larger boulders of granite, quartzite, etc. The whole extent of territory thus underlaid is between one and two square miles, and occupies portions of sections 27, 28, 33 and 34, in township 36 north, range 14 east. It is slightly elevated above the adjoining prairie, and on its northern slope, near the section line between sections 27 and 28, and farther west, the rock again appears at the surface. It is here a light gray limestone, apparently of a somewhat concretionary structure, and at one point, close to the road from Thornton to Blue Island, there appeared to be a strong dip, nearly 20° to the northeast.

The nearest locality to this place, where any rocks occur which can be identified with the Thornton beds, is in the northwestern part of section 1, township 36, range 13, about a mile southwest of

Blue Island, and distant from Thornton, in a northwesterly direction, about seven miles. Here, a bed of bluish, impure limestone, to all appearance identical with that occurring at Thornton, is worked as a hydraulic rock. Only the bluish strata are uncovered at this point, but some of the uppermost layers have been so changed by weathering as to present an entirely different appearance from the more recently worked beds below. A few fossil shells, *Orthocerata*, etc., have been obtained here, and fucoidal (?) traces are especially abundant. The dip here is very slight, 2° to 4° to the southeast; indeed, the prairie for more than a mile to the southwest of this point appears to be underlaid by this rock very near the surface; but in this case, the strata being very nearly horizontal, there is no very apparent elevation above the surrounding country.

One mile farther to the southwest, at the place of Mr. Henry Schwartz, in the southeast part of section 2, this bed is again quarried, and presents a similar appearance. About three miles west of this place, in the southeast quarter of section 5, on the land of Mr. Smith, there occurs an outcrop of limestone, on the banks and bed of a small stream. The rock here is a regulary bedded limestone, of a light gray color, where not weathered, and is very fossiliferous, although the fossils, for the most part, are only casts, and quite imperfect. At the eastern end of the outcrop the layers have a slight dip to the southeast, but a few rods farther back are horizontal. This rock is probably underlaid by the bluish hydraulic limestone, which outcrop, farther east, and, in this case, would be the equivalent of the upper strata at Thornton, and those exposed farther south, at Miller's. The fossils are identical in each case, and one species, the *Pentamerus Knightii*, especially abundant in, and common to, all these localities, has not been found by me in any other outcrops throughout the county. It seems to occur only in the beds overlying the bluish hydraulic rocks, which, as they do not appear to have been passed through by the Chicago borings, I have assumed to be the upper portion of the Niagara group, as developed in this county.

Along the eastern border of the county, north of the points already mentioned, the country is generally low, and exposures of rock are not numerous. The southernmost point where rock appears at the surface, is in the southern portion of section 1, township 37, range 14, where a bed of gray, fossiliferous limestone has been quarried. An area, equal to nearly half a section, is here underlaid by this limestone, covered only by a slight thickness of surface soil. Still farther north, in the eastern part of section 30 (fractional), township

38, range 15, the same rock occurs, but is here completely saturated with petroleum. The exposure is on the edge of one of the sand ridges bordering the lake shore, and consists of excavations of limited extent, made in former times, when the rock was quarried for the manufacture of lime. It is reported, also, that rock occurs in the bottom of the lake, near the mouth of the Calumet. I had no means of ascertaining the truth of this myself, but if so, it is probably a part of the same bed which appears in these nearest outcrops on land. North of this point, no exposures are met with until within the limits of the city of Chicago.

In the southern part of the city, in the quarter known as Bridgeport, a gray fossiliferous limestone is extensively quarried for the manufacture of lime. It here presents some peculiar features, being a massive concretionary rock, showing very little appearance of stratification, and varying in structure from a loosely compacted clayey rock to a solid bluish-gray limestone. This locality is especially rich in organic remains, and has yielded very many species of the fossils of this formation. The same beds occur again at a point near the track of the Chicago, Burlington and Quincy Railroad, about a mile and a half northwest of this locality, where they are likewise extensively quarried, and present similar characters. There is, however, a little more appearance of stratification, and the beds appear to have a slight and very irregular dip to the northeast. North of this, at the western terminus of Chicago avenue, are the artesian well quarries, where the limestone is completely saturated with petroleum. The presence of petroleum in such quantity in this outcrop may be only a local peculiarity, and in other respects its lithological characters are similar to those of the previously mentioned exposures in this vicinity; but there is, nevertheless, some doubt as to whether it can properly be identified with them. The scarcity and almost total lack of good fossils in this quarry is in striking contrast to their abundance in the other localities. If it is not the same bed it is most likely either immediately below or immediately above; the latter seems most probable, from the direction of the apparent dip.

West of Chicago, the nearest exposure occurs at Swazey's limekiln, in the southwest quarter of section 27, township 39, range 18, nearly on the line between sections 27 and 28, and four miles, in a direction about north 8° east, from Lyons station, on the Chicago, Burlington and Quincy Railroad. The rock in the quarry here is a regularly-bedded gray limestone, weathering yellow—a little darker in color than the average of the Chicago rock. The strata here dip

strongly in the direction south 50° east, the angle varying from ten to thirty degrees. By means of this strong dip, nearly forty feet in natural thickness of the strata is exposed. As is usually the case in the limestones of this group, some portions of the rock appear to be entirely made up of organic remains in almost undistinguishable fragments; nevertheless, well preserved fossils are extremely rare.

West of this point, for some distance, the indications on the surface are that the rock is not far below; but it does not appear above ground till we reach the Des Plaines river at Lyons, distant about four miles, in a nearly west by southwest direction. It seems probable that there is here a low anticlinal, with its steeper slope on the southern sides, and with a strike at first about west of southwest, but after the crossing of the Des Plaines, bending more to the southward, until it is lost under the accumulation of drift in that direction. The course of the Des Plaines is abruptly changed by this obstruction, when, coming from the north, through the Quaternary deposits, it first strikes the limestone of this ridge and bends suddenly to the northeast for about three-fourths of a mile; then, taking another sharp angle, runs about south of southeast for a mile and a half; after which it continues in a general southwesterly direction, through the ancient river channel by which the waters of Lake Michigan were discharged into the Mississippi Valley. This disturbance of the strata may be traced by means of scattering exposures and surface indications, for about four miles beyond the crossing of the Des Plaines at Lyons. Beyond this, the surface appearances cease, and outcrops are scarcely met with.

On the western bank of the Des Plaines, at Lyons, near the crossing of the wagon road from Chicago, a disused quarry shows beds of gray limestone, apparently the same rock as that which occurs farther east, dipping irregularly to the southeast and east southeast, at an angle of from ten to fifteen degrees. As in the before mentioned locality, good fossils seem to be rare, though the rock on weathered surfaces often shows an abundance of fragments of crinoidal stems, etc. At the two other quarries in the village the rock differs from that at this point. About half a mile nearly west of this place, and also near to the river, a light gray or grayish-white porous limestone is quarried for the manufacture of lime. No fossils were found in this quarry, nor was any regular dip observable. About a quarter of a mile southeast of this point the rock is again exposed in an abandoned excavation. It is here apparently a coarse yellowish limestone, showing scarcely any stratification whatever,

and is very fossiliferous. The fossils collected here were of two or three species of *Pentamerus*, *Pleurotomaria*, etc. These three exposures in the village are entirely disconnected, and it is not possible to exactly ascertain their relative positions. On the banks, and in the bed of the stream also, the river *debris* has so covered the rock that the particulars of dip, strike, etc., can not well be obtained.

In the southeastern quarter of section 11, township 38, range 12, a massive gray limestone, in many respects strongly resembling some of the Lyons rock, is quarried. No regular dip was observed here, and the limestone appeared to be altogether barren of fossils. The whole thickness exposed is only about six feet, about two feet in thickness of the upper portion appearing of a buff or pale-yellow color, most probably from weathering. About a mile southwest of this, in the northeastern part of section 15, on the open prairie, gray limestone appears in the bottom of ditches and natural water courses, and also upon the surface of the ground. In one place, where the rocks had been slightly excavated so that the dip could be taken, it was found to be between east and southeast, and amounting to from ten to fifteen degrees. The rock at this point is quite fossiliferous, the species mostly identical with those from the quarries in the city of Chicago. The species collected at this point were *Acidaspis Danæ*, *Illænus insignis*, *Meristella nitida*, *Atrypa reticularis*, *Stroph. rhomboidalis*, *Stroph. Niagarensis* (?), *Leptæna transversalis*, *Caryocrinus ornatus*, *Eucalyptocrinus*, probably *E. decorus*, fragments of a *trilobite*, apparently *Calymene*, and others. About a quarter of a mile farther to the southward, in an adjoining field, is another excavation of limited extent, which has yielded some large *Orthocrata* and *Lituites*.

At Mr. Harrison's place, still farther to the southwest, and about three miles from Lyons village, is a more extensive quarry. The limestone here is regularly bedded, the layers horizontal or nearly so, of a yellowish-gray color, and showing on weathered surfaces a great abundance of undetermined crinoidal remains. Complete and well preserved fossils, however, are not abundant. This rock appears quite suitable for building purposes, though the layers do not generally appear to be very thick. Mr. Harrison's house and barn are built of it. The only prominent outcrop to the southwest of this place, till we reach the county line, occurs on the land of Mr. Thomas Cook, in the southeast quarter of section 19, township 38, range 12, where a ledge of yellowish-gray limestone is to be seen, in the field on the southeast side of the road. It is also said to occur

in the bottom of a hollow in a field on the opposite side of the road, but was covered up at that point at the time of my visit.

It is possible that what has been called an anticlinal in the foregoing pages may prove to be an upheaval, with a fault, or a sudden drop to the southward, in the strata. None of the exposures on the line of disturbance show any decided dip to the northwest; the beds, wherever stratification is apparent, either dipping to the southeastward or apparently horizontal. On the western side of the Des Plaines, however, in some places, surface appearances seem to favor the theory of an anticlinal. Throughout its whole extent this disturbance borders, on the northwest, the least elevated portion of the county, the ancient river channel of the Terrace epoch, and its western limits are generally hidden under the accumulations of drift material, to which the elevation of the surface to the northward and westward is mainly due.

North of this line of disturbance outcrops of rock are few and scattering. One of these occurs near the residence of Mr. Frank Covell, in the northeast quarter of section 17, township 39, range 12. The outcrop is of a grayish limestone, weathering to a dark buff or brown color, the upper portion apparently somewhat decomposed and crumbling. No fossils, except imperfect crinoidal remains, were discovered. Another outcrop occurs about a quarter of a mile southwest of this point, and it is probable that the slight eminence above the surrounding prairie, on which these outcrops occur, is due to limestone strata lying not far below the surface. Nearly three miles due south of this, on the south line of section 29, limestone again appears, on the banks of Salt creek. The rock is, as usual, of a light-gray color on freshly fractured surfaces, but turns yellow after weathering. It has been quarried here to a very limited extent, and furnishes some fossils, among them very large specimens of *Pentamerus oblongus*, and a few corals and crinoids. The same rock, apparently, occurs in the bed of the creek as it enters the county, in the northwest corner of section 31.

A doubtful locality of rock is in the western part of section 18, township 42, range 12, on the land of Mr. Milo Winchell. Here it is reported that, in the years 1856 and 1857, limestone for the manufacture of lime was obtained; but that, on account of the supply failing, the work was afterwards given up. The excavation is of very limited extent, and, at the time of my visit, was so filled up with mud and water that no rock was visible. It is highly probable that this was a mere isolated mass, or boulder of limestone, of large size, and not a bed of rock *in situ*.

The principal exposures of rock which remain to be mentioned in Cook county, occur in that portion of township 37, range 11, which is included within its limits, and comprise the quarries and outcrops at Athens, and above, on the Des Plaines river and the canal. The upper beds at Athens are cherty, the chert distributed in nodules, between the thin layers of buff-colored rock; the nodules sometimes coalescing, so as to form a thin seam, or stratum, for a considerable distance, breaking off and renewing itself at intervals. These cherty strata can be seen at the foot of the bluffs, on the eastern side of the railroad (Chicago and Alton), in the village, and are also well exposed, in their lower portion, in the upper part of the Illinois Stone Company's quarry. Though its whole thickness is not to be seen at one point, yet the whole vertical depth of this stratum, from its uppermost exposures to where it joins the beds below, may be estimated as between fifteen and twenty feet. Below this, we find a compact, even-textured light-drab, or nearly white limestone, in regular beds or layers, the same material which, under the name of "Athens marble," is so extensively known and used as a building material in the city of Chicago and elsewhere. It is exposed in the quarries here to the depth of ten feet or more, and also forms the bed of the river and canal, at this place, for some distance above, and below to beyond the limits of the county. It also occurs at "the Sag," nearly four miles above, where there is also a quarry. This, at the time of my visit, was abandoned, and filled with water; but such of the stone as could be seen, appeared identical with that at Athens.

It is stated that the pot-holes, which have been already mentioned as occurring in the water-worn surfaces of the upper layers in the Athens quarries, when of sufficient depth to penetrate one layer and enter another, are occasionally found to be dislocated—that is, one layer has slipped upon the other, so that the upper and lower portions of the pot-hole are, in some cases, entirely separated from each other. I was not myself so fortunate as to observe a case of this kind, but the fact of their occurrence seems to be well attested. It would appear to indicate a slight disturbance of the strata, at a comparatively very recent period, subsequent even to the Terrace epoch, during which these holes were probably formed. The dip here is hardly perceptible, not more than one or two degrees to the southeast, in Singer and Talcott's quarries, where these appearances have been most observed—the disturbance is, therefore, very slight, and it is quite probable that it was also very gradual.

From only the scattered outcrops which have been enumerated in the foregoing pages, separated as they are by stretches of country more or less heavily covered with drift, it is impossible to, in all cases, ascertain exactly their relative position to each other, or the vertical range of the exposure in the formation. Sections taken beyond the limits of the county, however, seem to prove that the Athens rock is in the lower part of the series, probably within eighty or a hundred feet of the bottom, or even lower. It is probably the equivalent of the upper part of No. 4, of the Artesian well section, which has been given before. The only outcrops in the county which appear to me, by any possibility, to belong to a lower bed, are those occurring near its western border, in township 39, range 12, and leaving these altogether out of the account, as doubtful, we have, from one hundred and seventy to two hundred feet of vertical thickness between the uppermost and lowermost exposures. This, when we take into consideration the varied characters, both lithological and paleontological, presented by the different exposures, in many cases, at least, indicating entirely different strata, seems a sufficiently low estimate.

Fossils are not equally abundant in all the beds of the Niagara group, and in many places the nature of the rock, a concretionary magnesian limestone, is unfavorable to their preservation. In some localities, indeed, well preserved fossils, or even tolerable casts, are very rarely met with, though the rock itself is entirely made up of undeterminable organic remains. Other localities, however, have yielded abundantly, and enough is given to show that in the variety and abundance of its remains of animal life this formation is second to none of the sub-divisions of the Silurian, which occur in this State. Of the species which have been discovered in this county, the following may be enumerated as occurring at Chicago, and other localities where the upper portion of the formation is exposed: *Favosites Gothlandica*, *Diphyphyllum cæspitosum*, *Halysites catenularia*, *Caryocrinus ornatus*, *Atrypa reticularis*, *Meristella nitida*, *Spirifer radiata*, *Pentamerus Knightii* (?), *Strophomena rhomboidalis*, *Pleurotomaria gonopleura*, *Holopea Niagarensis*, *Cyrtoceras Fosteri*, *Illaenus insignis*, etc., etc. Over eighty species have been enumerated by Professors Winchell and Marcy, from the Bridgeport locality alone, and there are other localities in the county which would probably yield nearly as well, were they as extensively worked. The lower beds, at Athens and vicinity, contain comparatively few fossils, and *Pentamerus oblongus*, which is so characteristic of the lower part of this formation, has been positively identified from but one locality in the county.

Economical Geology.

Building Stone.—The supply of stone for building purposes is ample in Cook county, although its distribution is somewhat unequal. For this, however, there is a partial compensation, as by means of the numerous railroads centering in Chicago, the best materials in the county are easily accessible to all its parts. It is the lack of cheap material, for the rougher kinds of mason work, that is chiefly felt in those parts of the county most distant from available stone quarries.

The lower division of the Niagara group affords, in the Athens quarries, one of the best building stones in the State. The rock is a fine-grained, even-textured limestone, of an agreeable, light-drab color, when first taken from the quarry, and rubs well, though not capable of receiving a very fine polish. It is regularly bedded, the layers ranging from six inches to nearly three feet in thickness, thus affording dimensions and flagging stone of almost any required size. By exposure to the air it changes to a pale yellow, or buff color, which appears to be deepened by the smoky atmosphere of a city; in some cases, so much as to materially injure its appearance. Its accessibility to Chicago, and its general excellence as an ornamental stone, have made it almost the only material used, as the present time, in that city, for facing outer walls, and for general outside decorative architecture. From its adaptability to these uses, it has fitly received the name of "Athens marble," by which it is known wherever it is used.

The limestones occurring on the western banks of the DesPlaines, southwest of Lyons, furnish a good material for rough walls, and, when the beds are of sufficient thickness, answer well for general building purposes. The dark-colored bituminous limestone, which is quarried just west of the city limits at Chicago, is likewise used for the same purpose, for rough masonry, etc., in the city. The Second Presbyterian church is also built of this stone, which imparts to the edifice a peculiarly venerable appearance.

The upper beds of the Niagara group, which are found in the southeastern part of the county, afford a good material for rough walls, culverts and flagging, and are somewhat used for buildings. The quarries at Thornton have furnished a considerable part of the stone used in the culverts, etc., of the Illinois Central railroad in this county. The rock in most of these quarries is regularly bedded, the layers from six inches to a foot or more in thickness, and

appears well adapted to the purposes for which it is used. The bluish, impure limestone, which has been mentioned as occurring at Leavitt's quarry at this place, cracks and breaks up under the influence of the frost, when first taken from the quarry, and needs to undergo the process of weathering before being used as a building or foundation stone. The same bed is quarried near Blue Island, and exhibits the same qualities; but there it is worked less as a building stone than as a cement rock.

Lime and Cement.—The beds of limestone outcropping in the southern half of Cook county afford an inexhaustible supply of material suitable for the manufacture of a good quality of quick-lime. The gray limestones of the upper part of the Niagara group, at Chicago and in its vicinity, are most extensively used for this purpose. In the lighter-colored limestones of this group, some selection must be made among the beds to obtain the material for the manufacture of good lime. In the extreme northwestern portion of the county, where a band or stratum of worn fragments of limestone occurs in the drift deposits, lime-kilns are supplied with stone for burning by simply digging the boulders out of the hills. Mention has already been made of a bluish earthy limestone, which is quarried in the neighborhood of Blue Island for the manufacture of cement. The same rock is again met with in the village of Thornton, and at one or two points in township 35, range 14.

Clay, Sand, etc.—The sub-soils and drift-clays of various parts of this county afford a good material for the manufacture of brick, and are extensively used for that purpose. In many cases, however, the bluish clays of the drift are too calcareous, or contain too many small limestone pebbles, disseminated through the mass, to be suited for the manufacture of good brick. This difficulty was met with in the construction of the Chicago lake tunnel, the clay taken from the excavation of which it had been intended to make the bricks for the lining of the tunnel, proving entirely unfit for the purpose. The finer kinds of clay, suitable for pottery or a superior quality of drain-tile, seem to be entirely wanting. Sand, for building purposes, is sufficiently abundant in all parts of the county.

Peat.—In various portions of the county deposits of peat are known to exist, and have, in some cases, been worked to a limited extent. None of the beds yet discovered occupy any large surface of the country; they are, in most cases, of only a few acres in extent, and when of greater area are generally of very inconsiderable depth.

The surface-soil of the more recently formed wet prairies, or sloughs, of the eastern part of the county, is often peaty, and occasionally a deposit of true peat, of a considerable depth, is found in these situations. Such a deposit may be seen at Rose Hill Cemetery, seven miles north of Chicago, on the Milwaukee division of the Northwestern railway, in the southeastern corner of which a bed of peat has been excavated to a depth of four or five feet. The whole extent of this deposit has not been ascertained, but in many places on the adjoining prairie this substance forms the bottom and sides of ditches, one or two feet in depth. Other deposits of peat occur in similar situations on the eastern border of the county, and in the small prairie sloughs of the interior, but have as yet received very little attention. It is highly probable that, when this article becomes of more economic value, very many more localities of it will be discovered in all parts of the county. Deposits of fresh-water marl are sometimes met with in connection with peat-beds, or in very many similar situations. One such deposit occurs near the western border of Cook county, in the southern part of section 6, township 38, range 12, in a marsh which apparently was at one time a shallow lake. The marl here is covered by a thin layer of peat, and was discovered while making the track of the Chicago, Burlington and Quincy railroad. The whole extent of this deposit is not known.

Bitumens.—The presence of petroleum and mineral pitch, in some of the beds of the Niagara group in this county, has been already mentioned. In two localities only the true petroleum has been observed, impregnating the rock and filling its cavities. These are, respectively, the western limits of the city of Chicago, and in the eastern part of section 30, township 38, range 15. Farther to the south still, on the eastern border of the county, we find bituminous limestones; but here the more volatile matters have escaped, leaving only nodules of mineral pitch, or, in some cases, merely dark stains upon the rock. The cavities of the large corals (*Favosites*, etc.) found in the limestone, are also often filled with bitumen.

It is only in the upper part of the Niagara group that these bitumens occur; the lower beds yield scarcely a trace of them. At Chicago the bituminous limestone was found to be only thirty-five feet in thickness, and below it hardly any traces of oil were met till the boring entered the shales of the Cincinnati group, where the indications again appeared. Neither in the surface rock, nor in the shales, were there indications of oil in sufficient quantity to be of any economic value; nor does it seem probable, either from the lithological character of the bituminous limestones of the Niagara

group, or from their position as the uppermost rock in the county, that oil, in paying quantity, will ever be obtained from them. It is hardly possible, moreover, that oil in larger quantities than have heretofore been discovered, will yet be met with in the lower formations, and the indications certainly do not warrant any expenditure in this direction.

The water-gas, or light carburetted hydrogen, which was met with in great abundance in the drift clays, during the construction of the lake tunnel at Chicago, may perhaps have been derived from underlying beds of this bituminous limestone.

Minerals.—The metallic minerals which are met with in this county chiefly occur in the materials of the drift, and are derived from more northern deposits. The only exceptions to this are, the iron pyrites, which is sometimes formed, in small quantities, in the limestones of the Niagara group, and bog-iron ore, deposits of which will probably be yet discovered in some of the marshes and peat-bogs, though whether it will be found in sufficient quantity to be of any economic value, is very doubtful. Another of the ores of iron which is found in the county is the black magnetic oxide, or magnetites, small patches of which are frequently to be seen on the beach of Lake Michigan. As in other parts of the State, a piece of copper or galena is occasionally found in the surface deposits of this county, the latter, at least, probably brought to the place where it is found by human agency.

The soil of the upland prairies in this county agrees in general character and agricultural products, with that of other portions of northeastern Illinois, and requires no especial mention in this report. We will only say in regard to it, that when thoroughly and properly cultivated, it is always productive. In many portions of the county, however, where the land is comparatively level, attention must first be given to a proper surface drainage. The narrow belt along the eastern border of the county, near the shore of the lake, where the surface is alternately sand-ridge and low prairie, is of course inferior, but has acquired in many places a much greater value from its availability for residence sites.

Before closing this report mention must be made of the water supply afforded by the artesian wells in the city of Chicago. These wells range in depth from seven hundred to eleven hundred feet, and generally furnish an abundant supply of water for the local needs which caused them to be bored. The geological horizon from which the water comes is somewhat variable, as will be seen from

the range in depth, including, probably, all the beds from the lower Trenton to the upper part of the Calciferous, or lower Magnesian.

I must also here express my indebtedness to the Chicago Academy of Science, and to its Secretary, Dr. Stimpson, for valuable assistance afforded while I was engaged in the field work of the Geological Survey of this county.

CHAPTER X.

LA SALLE COUNTY.

BY H. C. FREEMAN.

This county is bounded on the north by Lee and DeKalb counties, on the east by Kendall, Grundy and Livingston, on the south by Livingston, Woodford and Marshall, and on the west by Marshall, Putnam, Bureau and Lee. It embraces an area of thirty-two townships, or about 1,152 square miles. Its surface, mostly prairie, is undulating, and generally well drained.

The Illinois river runs nearly centrally, in a west course, through the county. Its principal tributaries in the county, are Fox river, Big and Little Vermilion rivers, and the smaller ones, Pequamsoggin, Cedar and Covel creeks, and Clark's run.

There is, besides the undulation of the surface of the prairie, a considerable descent toward the Illinois river. The difference of level between the city of La Salle, at the Illinois Central Railroad station, and Mendota, is two hundred and thirty-nine feet, and between the LaSalle station and the north part of the county, where the railroad crosses the county line, is three hundred and seventy-one feet. Fox river shows a similar descent of the rock formations underlying the Drift and Coal Measures. The difference of level between the top of the St. Peters sandstone at the city of Ottawa and at the bend of Fox river, in section 5, township 35 north, range 5 east, is ninety-five to one hundred feet, the river bed to this point rising at a little less rate than the sandstone through which it runs. South of the Illinois river, the difference of level of several points on the Illinois Central Railroad, shows a considerable rise in the surface in that direction, but at a less rate than northward. Tonica is one hundred and forty-three feet higher than the station at LaSalle. The south lin of township 32, where the railroad crosses,

is one hundred and seventy-eight feet, and the Illinois Central Railroad survey shows a gradually increasing elevation in this direction, but with undulations, to a point five miles north of Bloomington, in McLean county, which is three hundred and sixty-seven feet above the station at LaSalle. The Illinois river, at LaSalle, at its lowest stage, is eighty feet below the LaSalle station, and the valley at this point is ten to twelve feet above the river at low water.

As the country on each side of this railroad is nearly level for long distances, these few elevations will represent the general descent of the surface toward the Illinois river in this county.

The surface soil of the prairie is generally a black mould, underlaid with a yellow marly-clay. Excepting the Illinois river, the streams have very little bottom land, the valleys being deep and narrow wherever they have been cut into the underlying rocks below the drift.

The Illinois valley is from a mile to a mile and a half wide, and varies greatly in its character in different portions of the county, which is due to the different geological formations that outcrop along its course. In the eastern part of the county, and from thence westward to the vicinity of Ottawa, the surface of the valley is formed in the lower part of the Coal Measures, the soil being siliceous clay, fertile and easily worked. This changes abruptly about one mile east of Ottawa, to the St. Peters sandstone formation, with little soil covering the rock, and many loose granite boulders scattered about. The city of Ottawa is built on this sandstone. The rock is so much exposed in the valley, and is of so friable a texture, that during the prevalence of winds, fine sand is constantly blowing. A considerable portion of the valley from Ottawa to Utica is rendered of little value for cultivation by the surface exposure of this sandstone. Near to Starved Rock, the Calciferous formation, underlying the St. Peters, comes to the surface, and some portions of this is so bare of soil as to be unfit for agricultural purposes.

Passing beyond this, westward to its junction with the St. Peters, on the west side of the axis, the dip of this and of the Trenton limestone is so abrupt as to bring the Calciferous very close to the Coal Measures. Here a marked change was noticed; the harder character of the Calciferous rocks had resisted the eroding action of the water in the valley better than the softer material of the Coal Measures, and the surface of the valley is mostly above the level of the freshets of the river; but, as soon as the Coal Measures are reached below Utica, the whole valley is denuded, so that it is annually overflowed by the rise of the river.

There is reason to suppose, also, that from the character of a boring put down opposite the city of LaSalle, the present surface of the valley does not represent the extent of the erosion by the river after it reached this part of the Coal Measures. A detailed section could not be obtained, the boring having been made several years since; but from general statements, it would appear that the erosion had extended in this part of the valley near forty feet below its present surface. This would be lower than the present bed of the river. There are evidences that the bed of the river within this part of the Coal Measures has changed its course in the valley. There is at present a bayou putting up from the river, near the mouth of the canal, which has at no distant date been a river channel, and probably the main one, from which, by some obstruction above the head of the bayou, the river was directed into its present channel. From the east line of the county there is considerable fall in the river, to where it strikes the Coal Measures, in section 24, township 33 north, range 1 east; but from this point the descent is very slight, and from thence, also, the bottom lands are very low, to the western boundary of the county, and subject to annual overflows.

Scenery.—The bold bluffs prevalent along the streams present at many points fine scenery, especially along the Illinois river, in the western half of the county, and along the Big Vermilion. Prominent among them is Starved Rock, near Utica, in the northwest quarter of section 22, township 33, range 2 east, rising perpendicularly from the Illinois river one hundred and twenty-six feet. Buffalo Rock is another, standing out in the valley as an island, which it has been at some former period. It is chiefly in the south part of sections 17 and 18, township 33, range 3 east, and is not as high as the former. From Starved Rock for several miles up the river, the sandstone bluff is indented at intervals with fissures having perpendicular walls, and, in length, from a few hundred feet to half a mile, forming canyons, some of which are places of popular resort. Another one, and best known, is Deer Park, on the farm of Wm. Clayton, Esq., on the southwest quarter of section 29, and northwest quarter of section 32, township 33, range 2. This puts out from a bend of the Big Vermilion, is about one-quarter of a mile long, and is in the form of an elongated letter "S," with high perpendicular walls, and abruptly terminating in a dome, open at the top, and about one hundred and fifty feet in diameter at the base, with a fine spring of soft water bubbling up at its base. In the wet season there is a beautiful waterfall of twenty-five feet, which

enters it through a narrow chasm at the head. The height of the dome is about seventy-five feet. This and part of the entrance is fringed at the top with pines. It is a place of almost daily resort throughout the year by visitors from this and neighboring counties.

Some bold limestone bluffs occur on the Big Vermilion, one mile south and southwest of Deer Park, and a sandstone bluff, several times recurring on the same stream, in townships 31 north, range 3 east and 32 north, ranges 2 and 3 east, form pleasant features in the scenery. From the fact that no roads cross this river, and the settlements are in the prairie, away from its banks, few seem to be aware of the character of the banks of this stream and its beauty. The bold mural cliffs of this stream, of the Illinois west of Ottawa, and the lower part of the Pequamsoggin and Little Vermilion, occurring as they do in a prairie region, form a novel contrast with the prevailing character of the county.

Timber.—All the streams are lined with timber on the bluffs and in their valleys; in the latter case the Illinois valley is, for the most part, to be excepted, being almost entirely open. There is a heavy growth of timber in the valley at the west side of the county, from Peru to the county line, and considerable growth at the east end for three or four miles. Along the streams entering the Illinois river, continuous bodies of timber exist; and in many places the timber is encroaching on the prairie, showing growths of from ten to twenty years. Old settlers quite uniformly speak of the timber encroaching on the prairies, which they attribute to the fires spreading less frequently from the prairie into the timber, destroying the young growth, since the country has become well settled.

The timber is chiefly oak of several varieties, in wet places, while birch and cottonwood were noticed on the bluffs. Crabapples are abundant in clusters and isolated trees; wild plums, also. These seemed more abundant along the Big Vermilion than elsewhere. Along the limestone bluffs cedars were common, with arbor vitæ; and the sandstone bluffs were often fringed with pines. The small undergrowth appeared to be mainly hazel. The sandy upper bottoms of the Big Vermilion were plentifully covered with wild gooseberries.

The wild grape, *Vitis estævalis*, was plentiful in the valleys, and to some extent appeared among the timber on the bluffs.

Geological Formations.

The great feature in the geological structure of this county is the anticlinal axis, extending diagonally across it, about north thirty-three degrees west, the central line of which may be seen where the Pequamsoggin emerges from the bluffs into the Illinois valley, on the south line of the southwest quarter of section 7, township 33, range 2 east, exposing here the upper portion of the Calciferous division of the Potsdam, which is the oldest formation that has been seen in this State, and has not been found outside of this county.

To the northward this axis is easily traced until it disappears under the drift, on sections 22 and 23, township 34, range 1 east. Its western slope is well defined at the junction of the Trenton limestone with the St. Peters sandstone, on section 22, township 34, range 1 east; at the junction of the Coal Measures with the St. Peters, on the northwest quarter of section 35, township 34, range 1 east, near the mouth of the Tomahawk; also along that stream in the section next north, at the junction of the St. Peters with the Calciferous formation; at the railroad tunnel, on the northeast quarter of section 13, township 33, range 1 east, where the junction of the Trenton limestone with the St. Peters is clearly seen; at Little Rock, on section 19, township 33, range 2 east, in the St. Peters; at the entrance to Deer Park, on the northeast quarter of section 31, township 33, range 2 east; at the junction of the lowest beds of the Trenton limestone with the St. Peters; and at Big Bend, in the northwest quarter of section 5, township 32, range 2 east, where the lowest beds of the Trenton are exposed.

The formations exposed in this county, below the drift, are Coal Measures, both upper and lower; Trenton limestone, St. Peters sandstone, and the upper part of the Calciferous division of the Potsdam period.

West of the axis the Coal Measures, where resting on the Trenton at the outcrop, are inclined at an angle of about ten degrees, the dip of the Trenton being forty degrees. The Coal Measures extend over and rest unconformably on the St. Peters also, at about the same angle. The Trenton and St. Peters are everywhere conformable to, and appear to be the same with, the Calciferous.

The good exposures of Trenton and St. Peters, from Deer Park northward, on the west side of the axis, give a dip of forty degrees

to the southwest. Southward from Deer Park the dip becomes less, being about six degrees at Lowell, with Coal Measures still unconformable at a less angle.

The eastern dip, near the axis, is only one or two degrees, and a couple of miles east of the axis the formations are level in that direction, or very nearly so; that is, in a line about at right angles with the axis. There is a gentle dip to the southeast.

North of the Illinois river, east of the axis, and in the Illinois bluffs on the south side, the Coal Measures resting on the St. Peters sandstone are conformable to it. Farther south there seems to be an increasing dip in a southeast direction of the sandstone, or a less dip of the Coal Measures, and the Trenton comes in between. This may be seen in Covel creek, near its mouth.

The section annexed, shown in the margin, taken on the north side of the Illinois river, extending from LaSalle to near the east line of township 33, range 2 east, exhibits the relations of the several geological formations as they occur—a, is the Calciferous; bb, St. Peters sandstone; c, Trenton limestone; dd, Coal Measures.

It will be seen that the Trenton does not appear on the east side of the axis in this section, and that in place of it the Coal Measures rest conformably on the St. Peters. East of the axis, north of the Illinois river, and for some miles south, only the lowest bed of coal occurs, excepting in that part of the county from Marseilles eastward, where the middle LaSalle bed may be found in patches.

The St. Peters sandstone is the formation underlying the drift over nearly the whole of the northern part of the county, and covers about one-third of the entire area; the Coal Measures occupying a similar position over nearly all the rest of the county; the Trenton and Calciferous together covering not more than one township.

At the railroad tunnel, one and a half miles east of LaSalle, the Coal Measures, Trenton limestone,

St. Peters sandstone, and the Calciferous formation may be seen exposed in place in a distance of less than one quarter of a mile. At the entrance of Deer Park this is repeated without the Calciferous, but with finer exposures of each of the other divisions.

Drift.—The drift covers the entire county, except in the valleys of the larger streams. It is of variable thickness, from a few feet, on the margins of the streams, to over one hundred in the prairie, probably as high as one hundred and fifty feet.

The tributaries of Fox river do not cut through to the bottom of the drift more than one or two miles above their mouths; and their beds, also those of Fox river, are paved with limestone boulders of Trenton, and some apparently as recent as Niagara. In Fox river they could have come long distances down the river, but in the small tributaries they must have been washed from the drift through which they run. Above the mouth of Mission creek the quantity is much greater than below. The Little Vermilion does not cut through the drift above section 25, township 35, range 1 east.

The tributaries of the Big Vermilion are all short, and afford very little exposure for observations, as their beds soon rise above the bottom of the drift.

Along the crown of the great axis, from near Big Bend, in the Big Vermilion, to section 15, township 34, range 1 east, the drift is thin, and in some places the underlying rocks are bare.

The records of many wells and some borings were obtained in the northern half of the county, and some in the south part, from which it appears that the order of stratification of the drift is, first below the soil a yellow, marly clay, three to ten feet, usually about five feet; gravel from a few inches to five feet, and sometimes wanting; blue clay of very variable thickness, from a few feet to forty; then a gravel bed, thickness not known, as where this is found there is an invariable good supply of water. Although this seems to be the general order of deposit of the later portion of the drift, it varies in different places, and the blue clay reaches a much greater thickness, the gravel bed being absent, and the blue clay above and below this gravel being united in one stratum. The gravel bed, however, is widely extended and generally found. Where thick, the drift is mainly blue clay.

The supply of water for the city of Ottawa, furnished by J. D. Caton's water works, is obtained from one of these gravel beds on the bluff, one hundred and twenty-five feet above the level of the city. The water is collected to fill the pipes by simply extending a

line of large drain tiles into the gravel bed on a level and near the bottom, the opening being made by cutting into the side from the slope of the hill. The greatest thickness of gravel found here was nine feet, and the bottom of the gravel is sixteen feet from the surface of the soil. This appears to be the upper gravel bed.

Wells sunk to this second gravel bed in the prairie are reported to be never failing, and the water flows in too fast for them to be drained in the ordinary way. The upper gravel bed is not always as reliable a source of supply, though in some instances the wells are reported as never failing in summer.

Some borings, of which the record was obtained, show the thickness of the drift. One, on the northwest quarter of the southeast quarter of section 23, township 35, range 2 east, shows the drift to be sixty-three feet deep. This boring was commenced about twenty feet above the Tomahawk. Another, in the same township, in the northwest quarter of the northwest quarter of section 26, is as follows:

Soil	1 foot
Yellow clay and small stone or gravel	15 feet
Blue clay	85 feet
Gravel	20 feet
To St. Peters sandstone.	
	121 feet

This boring is on an elevation from thirty-five to forty feet above the other, and is the highest land in the vicinity. One in the west half of the southwest quarter of section 28, township 34, range 2 east, reaches St. Peters sandstone in twenty feet.

A series of twelve borings, in the east half of township 31, range 3 east, lying east of the Big Vermilion, shows the drift to be from twenty-nine to sixty-one feet; mostly from thirty to fifty feet. East of this it is probably deeper.

A boring at Minonk, just outside the southern limits of the county, went through the drift one hundred and forty-one feet, to the Coal Measures.

From examinations made, it was found that almost everywhere good supplies of water may be obtained by sinking wells from fifteen to forty feet. Another source of supply will be noticed under the head of artesian wells.

In the drift is found a variety of boulders, from a few inches to several feet in diameter, and they are often found collected in quantities in the little washes adjacent to the larger streams. They consist of granite of several varieties, trap, greenstone, hornblende, and quartz. Occasionally pieces of copper have been found, from

an ounce to seventy pounds in weight; and agates, quartz and jasper. Of the latter, I found a boulder fifteen inches in diameter, on top of the prairie.

Coal Measures.

The Coal Measures occupy about two-thirds of the area of the county, underlying the drift. West of the great axis running through the county, the upper and lower Coal Measures are found nearly co-extensive, with a maximum thickness of over five hundred feet; while east of it, for the most part, only the lower measures are found, and quite differently related to the older rocks below. East of the axis, wherever the base of the Coal Measures showed an exposure, they rested conformably on the St. Peters sandstone, except at the mouth of Covel creek, where the Trenton limestone comes in between.

West of the axis, wherever there are exposures showing the base of the Coal Measures, they rest unconformably, either upon the Trenton or St. Peters, and have everywhere, at the eastern outcrop along this line, an abrupt termination, forming nearly a straight line from the mouth of the Illinois river to section 16, township 34, range 1 east. At this point the line of boundary bends westward, running near the southwest corner of section 9, and through the south part of sections 7 and 8, to the county line. West of the axis, north of the Illinois river, and west of the Big Vermilion, south of it, there appear to be three continuous workable beds of coal, locally known as the upper, middle and lower beds; or, first, second and third beds, numbering from the top downwards. Of these, only the lower bed is found east of the axis, and of the Big Vermilion, with the exception hereafter noticed.

A fourth workable bed appears in the south part of the county. The course of the Big Vermilion appears to have been determined by the influence of the axis south of the Illinois river, in disturbing the strata of the Coal Measures. Evidences of this are apparent, extending far into Livingston county. A full section of the Coal Measures, as exposed in this county, is as follows: At the point where the top of the section was taken, the drift covered the Coal Measures to the depth of ten feet, consisting of gravelly clay, covered with soil.

Section.

1.	Clay; blue and shaly, ochreous toward the bottom	3 feet
2.	Coal; soft and rotten	1 "
3.	Clay; shaly, dark olive-colored, some ochreous; bottom 1 foot dark reddish-brown	11 "

4.	Limestone; argillaceous, slightly shaly	1	feet	8	inches
	Limestone, fossiliferous and argillaceous, solid	1	"	6	"
5.	Shale; olive-black, bituminous, grayish	1	"	8	"
6.	Marly limestone; fossiliferous	2	"	8	"
7.	Coal	1	"		
8.	Fire-clay	0	"	3	"
9.	Blue shale, underlaid with brown	15	"		
	Blue shale	2	"		
	Brown shale	8	"		
10.	Limestone; gray, seven to nine feet (LaSalle quarries)	9	"		
11.	Shale; blue and grayish, one to three and a half	3	"	6	inches
12.	Limestone; gray, seven to twelve feet	12	"		
13.	Shale	5	"		
14.	Limestone; blue	5	"		
15.	Black slate	7	"		
16.	Coal	0	"	6	inches
17.	Blue shale	9	"	6	"
18.	Blue limestone	1	"	7	"
19.	Blue shale	9	"	3	"
20.	Blue limestone	3	"	5	"
21.	Coal	0	"	1	"
22.	Fire-clay	0	"	3	"
23.	Blue shale	17	"	1	"
24.	Gray limestone	3	"	6	"
25.	Blue shale	9	"	6	"
26.	Gray limestone	2	"	6	"
27.	Blue shale	12	"		
28.	Blue limestone	2	"		
29.	Blue shale	1	"		
30.	Black slate	2	"	6	inches
31.	Blue shale	13	"		
32.	Limestone; marble-streaked	4	"		
33.	Blue shale	2	"	8	inches
34.	Blue limestone	0	"	6	"
35.	Brownish-red shales	2	"		
36.	Limestone	0	"	4	inches
37.	Brownish-red and brown shale	14	"	6	"
38.	Sandstone	18	"		
39.	Siliceous shale	19	"		
40.	Slaty shale	11	"	4	inches
41.	Black slate	6	"		
42.	Coal, four and a half to five feet	4	"	6	inches
43.	Fire-clay	6	"		
	Dark-colored and brownish clay	15	"	9	inches
44.	Sandstone	34	"		
45.	Black slate	10	"		
46.	Coal, three to nine feet, usually six	6	"		
47.	Fire-clay, two to four feet	4	"		
48.	Shale, siliceous and argillaceous	30	"		
49.	Sandstone, fifteen feet, increasing in the south and southwest part of the county to thirty-five feet	35	"		
50.	Shales, blue-brown and black	9	"		
51.	Black slate	2	"		
52.	Black and greenish clay	1	"		
53.	Argillaceous limestone	2	"	6	inches
54.	Shales, brown and olive, with limestone	2	"		
55.	Black argillaceous limestone	0	"	4	inches
56.	Black slate	2	"	9	"

57.	Fire-clay five feet; blue clay six feet	11	feet		
58.	Argillaceous limestone	1	"		
59.	Blue clay shales, with bands of nodules	22	"		
60.	Black slate	1	"	4	inches
61.	Sandstone; argillaceous	1	"	6	"
62.	Dark clay shales, with septara in the bottom	8	"	5	"
63.	Black slate and shale, with nodules, spherical and oval	2	"	9	"
64.	Blue clay, some shaly, fifteen to	18	"		
65.	Coal	4	"		
66.	Fire-clay, thin and sandy, six to ten inches	0	"	10	inches
67.	Sandstone, three to	6	"		
68.	Fire-clay, light and dark-blue	6	"		
69.	Brown shales; bottom siliceous	5	"		
70.	Black slate and shale	6	"		
		515	feet	0	inches

Fossils.—The highest fossiliferous bed found is the limestone numbered four in the section, containing *Spirifer plano-convexus.* The marly limestone, No. 6, has abundance of *Chonetes Flemingi, Hemipronites crassus,* and *Myalina recurvirostris.*

No. 10, which is the LaSalle quarry rock, contains *Productus costatus* (?), *P. punctatus, Spirifer cameratus, Athyris subtilita*—all abundant—and sometimes *Pinna per-acuta,* and *Conularia.* Found a single specimen of *Macrocheilus* undetermined.

No. 45 contains *Solenomya soleniformis,* Cox, and an *Orthoceras* both in pyrites. If not mistaken in the identity of the Kirkpatrick coal, referred to hereafter, the slate over which would be No. 45 of the section, there also belong to this stratum, *Solenomya radiata, Aviculopecten rectilaterarius, Cardinia fragilis, Petrodus occidentalis,* or dermal plate of fish, *Nautilus Illinoisensis, Orthoceras Rushensis,* McC., *Nucula, Goniatites, Discena, Pleurotomaria,* etc.

No. 48—Sandstone.—The base of this, wherever exposed, shows more or less broken fragments of fossil coal plants undetermined, with *Sigillaria* and *Calamites* not uncommon. A single very handsome specimen of *Lepidodendron* was seen, taken from this at Marseilles. This bed of fragmentary fossil plants is the more noticeable because, in Livingston county, it is represented by a bed of coal eighteen inches thick.

No. 53—*Rhynchonella Uta, Spirifer Kentuckensis, Spirifer plano-convexus, Orthis Pecosii, Chonetes Mesoloba, C. Flemingii, Hemipronites crassus, Bellerophon carbonaria,* and *Pleurotomaria grayvillensis.* Fossil wood was found in the black shale above this stratum, in a shaft of the Illinois Valley Coal Company, near LaSalle.

No. 51.—Black slate has *Aviculopecten,* and small, flat, lensiform nodules, about one inch in diameter. None found containing anything organic.

No. 52.—*Hemipronites crassus*, M. and H., *Chonetes Mesoloba*, *C. granulifera*, *Athyris Royissii*, *Productus longispinus*.

No. 53.—*Chonetes*, *Productus longispinus*, *Lophophyllum proliferum*, (?) McC., and *Crinoid stems*, very abundant.

No. 56.—Black slate, *Aviculopecten retilaterarius*, and occasional large nodules of black argillaceous limestone, oval or flattened. In section 5, township 31, range 3 east, near the south line of the section, where this slate makes its last appearance in ascending the river, it has four inches of good coal underlying it, the bottom two inches of slate being almost a cannel coal. This slate and 51 are almost invariably found exposed together, with the associated strata between, and increasing in thickness southward.

No. 60.—This, I think, is the representative of the Trenton coal, which, with its accompanying fossils, will be noticed hereafter.

No. 62.—In the bottom of these shales are many septaria; large specimens are common, some as much as two and a half feet in diameter, form irregular spherical, the internal markings generally beautiful.

No. 63.—The nodules of this stratum are black argillaceous limestone, probably ironstone, form mostly spherical, all sizes up to a yard in diameter, some flattened, and oval, occasionally spherical, with an equatorial band.

No. 65.—Lower LaSalle coal.—Fossils found were *Solenomya radiata*, M. and W.—*Nucula ventricosa*, Hall—in the clay over the coal. A very small specimen of *Lepidodendron* was found. Fossils are rare in this county, associated with this coal, so far as my observations extend.

In the section, from forty-six downward, there is an increase of thickness, apparently in a southern direction, in the outcrops of the Big Vermilion.

The lower LaSalle coal, No. 65 of the section, has been traced, with its associated strata, to the vicinity of Morris, in Grundy county. It is undoubtedly coal No. 2 of the Illinois river section, established in the Illinois survey, the equivalent of the fine coal at Murphysboro, in Jackson county.

The middle LaSalle coal, No. 46 in the section, is coal No. 5 of the Illinois section, according to Prof. WORTHEN'S general section of the Coal Measures in central and northern Illinois; and the upper LaSalle coal, No. 42 in the section, is No. 7 of the Illinois section.

The coal found in the south part of the county, at Streator, not shown in the section, would come in as No. 4 (?) of the Illinois

section. No. 5 is considered by Prof. WORTHEN as the equivalent of the DuQuoin bed in Perry county.

The upper part of the section, down to No. 10, was taken in the excavation of the Illinois Central Railroad, adjacent to LaSalle, the only places affording good exposures. From 10 to 43, the section is chiefly from the shaft of the LaSalle Coal Mining Company, that being the best detailed record of this portion. From 43 to 70 is from shafts of the Illinois Valley Coal Company, Northern Illinois Coal and Iron Company, and Peru Coal Company, compared with outcrop observations along the Big Vermilion. The best and most carefully kept detailed record of this portion, by either of the coal companies, is that of the Illinois Valley Coal Company. The extreme bottom of the Coal Measures was not seen.

After a very careful search among the outcrops, I was unable to find anything lower than No. 68, which appears to be the usual parting between the Coal Measures and the Trenton, where they meet. Nos. 69 and 70 were obtained from shafts.

The exposures of the Big Vermilion, from its mouth to Vermilionville embrace the whole section, except Nos. 69 and 70, different portions being seen at intervals. Above Vermilionville, to section 8, township 31, range 3 east, the exposures along the river are from No. 48 to 62, the frequently recurring sandstone bluff, with from twelve to eighteen feet of massive sandstone, being No. 49.

In this division of the river there is no workable coal outcropping in the banks, though coal numbered 46 in this section would generally be found not far from the left bank. In a single instance, it was found outcropping in the left bank, at low-water level, sixteen to twenty inches thick, on the northwest quarter of the southwest quarter of section 24, township 32, range 2 east.

One hundred yards down the river from this point, on the right bank, a boring, made eight or ten feet above the river bed, struck the coal numbered 65, at forty-five feet, or about thirty feet below the bed of the river. It is here reported four and a half feet thick. This latter coal, known locally at LaSalle as the lower bed, everywhere, above Vermilionville, underlies the river. Below that point it is mined above the river, at Lowell, and at intervals as far down as half a mile below Deer Park. The coal mined at Big Bend is this bed. The coal exposed high up in the bluff, which can be seen to the south from the entrance to Deer Park, is No. 46 of the section, or LaSalle middle bed. It is here two feet five inches thick, and has a covering of shale.

No. 65 is concealed behind the talus below. No. 42 may also be seen in the point of the bluff formed by the first ravine, higher up the river, on the same bank. This is the LaSalle upper bed. The lower bed has also been mined extensively at its outcrop at the railroad tunnel, and along the Little Vermilion; also worked at Ottawa, and along the river bluffs west of there, at Dayton, and northeast of Utica.

Above section 8, township 31, range 3 east, there is a sudden change in the appearance of the sandstone No. 49, with an increase of thickness, how much, not determined, as the base was not seen; and, presently, a coal bed appears above, known as the Kirkpatrick coal. It is first seen in the east part of section 8, extends across section 9, seen on both banks here, and reaches a short distance into the southwest corner of section 10, and abruptly terminating near where the line between sections 10 and 11 crosses the river. At this furthest point up the river, it is known as Cook's bank. It increases in thickness ascending the river, and at Cook's bank and Kirkpatrick's openings, one quarter of a mile below, it is eight feet thick, with a covering of eight feet of black slate, the lower four feet of which is highly bituminous. The slate is covered with about eight feet of gravelly clay of the Drift.

The appearance of the strata underlying this coal, where the river crosses it at the lower end, indicates a fault; but at the upper end, at Cook's bank, it is somewhat like a shelving shore at the line dividing it from the adjacent strata. As a whole, it looks like an ancient river valley filled up. I felt great uncertainty at first about the identity of this coal; but, after visiting it three times, and a very careful study of the adjacent strata, I became convinced that it is the LaSalle middle bed, No. 46 of the section. The river crosses through it for about one mile and a half. It is either an isolated outlier of this bed, or is connected with the main body in a southwest direction. I am inclined to the opinion that its appearance, as presented here, is due to two faults, letting it down from a higher level, where it would belong according to the adjacent strata on each side; the greater fault being on the down-river side.

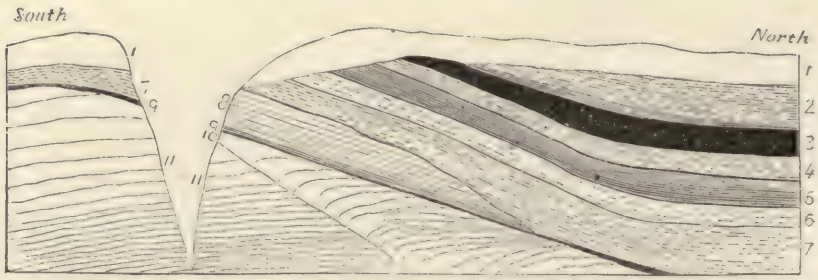
Above this point, no coal appears again in the river bluffs until opposite the mouth of Eagle creek, in the southwest corner of section 23 of the same township. Here, another bed of coal, not before seen, comes in abruptly. It is variously known as Eagle creek, Prairie creek, Hard-scrabble and Reading coal, from the several localities where heretofore mined; but will be henceforth more extensively known as the Streator coal, from the town of that name

recently established by the Vermilion Coal Company, on the east bank of the river, in the southeast quarter of section 26, in the same township, which has now become the principal mining point, and from which the coal company has this year (1867) completed a railroad to Wenona, on the Illinois Central Railroad, twelve and a half miles distant.

No boring having been made down to the coal which is below No. 65 of the section, I am unable to determine its position absolutely; the few fossils obtained being different from any obtained elsewhere, and the exposures of the strata not affording the means of tracing the connection with certainty. I feel tolerably certain, however, that its place in the section is represented by the black slate, numbered 60.

The general section was made up entirely from the shafts and exposures of the Vermilion, from its mouth to township 31, range 3 east; throughout this range everything being easily traced.

There is a fine exposure in the bluff on which the town of Streator stands, of the strata overlying this coal. It is a body of clay, slightly arenaceous and micaceous, the upper portion shaly, and is from twenty-five to thirty-five feet thick, the increase of thickness up the river, just above the town; the coal and strata above dipping to the southeast. This clay is interstratified with numerous bands of nodules, mostly of sandstone, with a band or two of small septaria, fifteen or twenty feet above the coal. The nodules change somewhat on ascending in the section, showing a little lime and iron forming ironstones. The dip carries the coal under the river near the south line of the town. Another exposure, half a mile below the railroad bridge, near the north line of the southwest quarter of section 26, on the left bank of the river, affords a detailed section below the coal, which is given below. From the town to this point the river runs on the outcrop, cutting off the coal from the left side. The coal crosses at the point where the section is taken. Here, the river runs due north.



The cut here given of the section will show this outcrop, which is repeated almost identical, on the right bank of the river, opposite the mouth of Eagle creek, half a mile below.

1.	Soil and clay	0 feet	
2.	Shales	0 "	
3.	Coal; *Streator bed*	5 "	
4.	Dark shale	1 "	
5.	Black slate	3 "	
6.	Clay; olive, brown and ochreous, with bands of nodules; four inches of fire-clay at the top, and two inches of argillaceous limestone at the bottom	2 "	
7.	Shale; blue at the top, dark and almost a slate at the bottom, with bands of dark nodules, and two bands of argillaceous limestone each four inches thick	11 "	2 inches
8.	Sandstone; thin-bedded	6 "	0 "
9.	Coal; twelve to eighteen inches	1 "	6 "
10.	Shaly sandstones; gray	2 "	6 "
11.	Sandstone; mostly thin-bedded	25 "	

The base of the sandstone is not seen here; but half a mile down the river, where it appears again, it rests upon shale, somewhat siliceous. No. 5 has some indistinct fossil impressions—several forms of Ganoid fish-scales, impressions of fish-teeth, and *Lepidodendron*. The nodules of No. 6 contain beautifully preserved specimens of *Leia*. They are also found in the bands of limestone of No. 7; and in the slate of No. 7 a few leaves of *Neuropteris hirsuta*. In the bottom of this were a few *Calamites*.

In digging a drain below the coal-bed, in the mine, a very fine branching specimen was found of *Lepidodendron* (?), and fine large leaves of *Neuropteris hirsuta*. These were from No. 5 of the section. Another exposure of the strata between two and eleven, one-fourth mile above the bridge, and close to town, does not afford as complete a section. The thin bed of coal is entirely wanting.

The record of a series of thirteen borings made by the Vermilion Coal Company, kindly furnished by the secretary, Colonel Ralph Plumb, materially assisted me in studying this coal. They show that the northern boundary of this coal runs in a northeast course from the mouth of Eagle creek, through the southeast corner of section 14 and in the northeast quarter of section 13, trending east without touching the north line of 13. Its course was not traced farther east. From my own observations I am satisfied that its extent west of the river, at its northern boundary, is confined to the little strip in the northwest quarter of section 26, and a triangular shaped piece in the north half of section 27, extending up Eagle creek, probably not more than one mile, the creek forming its northern boundary. This appears to be the northwest corner of the general area of this coal-bed. It may be on the west side of the river

again, in section 35, and extend into 34, possibly. By the borings the coal was found to range from four and a half to five and a half feet in thickness. Where mined at the town it is five feet.

A noticeable feature of this bed at Streator is a thin blue clay band, one-fourth of an inch thick, running through it, about three feet from the top. Near the southwest corner of the southeast quarter of section 36, this clay band has increased to six or eight inches, while no increase was observed in a boring one-half mile northwest of this point. Near the southeast corner of the northeast quarter of section 1, township 30, range 3 east, Livingston county, this band has increased to one foot. Near the southwest corner of the southeast quarter of same section it is fifteen inches, and farther up the river, in Livingston county, its thickness is reported at two and a half feet, showing a regular increase; but no data was obtained far enough up to show the limit of this increase, as the coal goes under the river finally a few miles above Streator, and affords no farther range for observation. Whether it is two beds of coal that come together near their northern border, or whether this is a clay parting that runs out again to the south, is yet unknown. I am disposed to regard it as two beds, and the difference in quality of the upper and lower portions favor this idea. The upper portion is much the best coal, according to common report.

The thin bed, twelve to eighteen inches thick, underlying this coal, is mined to some extent on Eagle creek, and is reported to be of finer quality than the other, though the upper three feet of the Streator coal is of superior quality. The roof of the Streator coal is clay, somewhat siliceous, hard and firm, and appears to stand well.

Area of the Coal.—All that portion of the map showing the Coal Measures, is underlaid with the lower bed—coal No. 2, of the Illinois general section—except at some points in its northern margin, where only the underlying clay will be found; but, generally, the coal will be found not far from the margin. On account of its thinness, and the amount of covering over it, throughout a large area it has no value. This is the case with all that lying between Utica and Fox river, north of the Illinois, and the northern half or two-thirds of that lying between Fox river and the east line of the county, north of the Illinois. The exceptions to this are where, from a good bluff exposure and a thin covering, it may be profitable to work it in a small way, by stripping the overlying strata. It is worked some in this way northeast of Utica, along the bluff of the Illinois, on top of Buffalo Rock, in the bottom adjacent to Ottawa, and near Dayton. In the northwest quarter of the southwest quarter

of section 35, township 34, range 2 east, it is reported twenty-two inches in a well. Eighty rods east of the center of section 4, township 33, range 2 east, where the road crosses Clark's run, a little outcrop of light-colored clay may be seen, which is No. 68 of the LaSalle county section underlying this coal. The coal does not extend so far west at this point. In the northwest quarter of section 3, it is found eighteen to twenty-two inches thick.

By the wells, some of which were sunk to the St. Peters sandstone, and borings put down in the southeast quarter of section 23, and northwest quarter of section 26, which reaches St. Peters sandstone, together with the depression of the country forming the sloughs of the Tomahawk, I was able to define the Coal Measures across this township (township 34 north, range 2 east), with tolerable certainty. Between that township and Mission creek no positive data was obtained. The coal thins out ascending Fox river, and the last trace of anything reliable was obtained in Mission creek. A few inches of coal in the bluff above the mouth, and some small fragments of fossil plants in sandstones, belonging to the Coal Measures, was all that was obtained here.

With this data, and what was derived from a general study of the St. Peters sandstone immediately underlying it at all the sections north of the Illinois, east of Utica, I fixed the boundary of the Coal Measures, as indicated on the map. Some lumps of coal have been found in gravel at Milford, where Fox river enters the county; also, four inches of coal, overlaid with sand, was found in the bend of the Little Vermilion, in the southeast quarter of the northeast quarter of section 35, near Homer. Near the center of section 25, about one mile and a quarter above the last point, a similar deposit was reported as having been found. These I regard as only evidences that, prior to the Drift period, the coal extended farther north than it does now.

Below Dayton, near the town, the coal is eighteen to nineteen inches thick, and has been worked some. At the mouth of Fox river, it is twenty-two inches. At Marseilles, a boring in the bed of the tail-race reached it thirty-nine feet below, reported here to be twenty-five inches thick. No data with respect to this coal was obtained east of this point, nearer than Morris.

At Marseilles, in the river bank, near the bridge, the slate No. 51, or 56 of the LaSalle section, appears in the bank. This shows, in connection with the boring referred to, that the lower part of the Coal Measures are thinning out to the eastward. The sandstone bluff at the town is No. 49 of the section, and is here thirty to thirty-

five feet thick. A fine specimen of *Calamite* was obtained from the base of this. Half a mile east of this, coal No. 46 of the section has been opened and worked. Its area was not determined, but it appears to be quite limited, like a pocket. A very fine specimen of *Lepidodendron* was shown me, taken from the sandstone at the town.

Along the south bluff of the Illinois river this lower coal ranges from twenty-four inches, at Ottawa, to two feet and six inches east of Little Rock, near the mouth of Vermilion. At Little Rock, on the west side of the axis, it is three feet and six inches. This coal becomes thicker southward. The farthest south I have knowledge of it, is the report of a boring in section 24, township 32, range 2 east, where it is four and a half feet thick. Along the Little Vermilion the outcrops of it are from two and a half feet to three and a half feet thick where worked. In a shaft of the Northern Illinois Coal and Iron Company, it is four feet thick; the same in the Peru shaft, and the Illinois Valley Coal Company's shaft, and three feet and a half in the Kenosha shaft, one mile southeast. These are the only shafts that have been sunk to it away from the outcrop. This coal, where worked, varies very little in thickness, and is quite uniform in quality. A bad feature about mining it, is the character of the roof, which is clay, and requires to be well supported; the rooms for the same reason should be worked with less width than the beds above, which have good slate roofs.

The Streator Coal, which is the next workable bed above this, has been before referred to, and its northern boundary, so far as known, described. In a southwest direction, it is possible this bed may extend over the greater part of township 29 and 30, range 2 east, but nothing whatever is known about it in these townships.

The LaSalle Middle Bed—No. 46 of the section—has a peculiarity not found in either of the others. It has a tendency to a lensiform arrangement, caused by resting upon an uneven bed. The covering, also, is uneven, apparently from the action of currents, leveling down the strata over the coal, and sometimes part of the coal itself. This feature has given rise to the opinion, among those not familar with it, that where the coal is decreasing in thickness, it is going to run out where mined in the shafts. This is also the cause, I suppose, of its less frequent appearance than the other beds in the outcrop, and the great thickness it sometimes reaches—eight to nine feet.

To the west of the great axis, there is a gentle synclinal axis, the center of which, from observations in the bluffs of the Illinois, appears to be about at the mouth of the Little Vermilion; and it runs par-

allel with the great axis. This is confirmed by the lay of the coal, as found in mining from the shafts that lie near this line. The strata rise again to the westward, about fifty feet to the mile, to a point in Peru, where a gentle anticlinal gives a western dip again. The Peru shaft was struck on this anticlinal, and the company, failed to find the middle coal; but found the strata below regular to the lower coal, which they mined. On this axis, at this point, the middle coal has been cut away in the manner before described, I suppose; and it is not improbable that along this axis this coal will be as uncertain as along the upturned eastern outcrop of it. I think it can always be depended upon a little distance away from either anticlinal, toward the synclinal axis, and again to the westward of Peru. This anticlinal at Peru appears to be parallel with the main axis, about north 33 degrees west.

This bed of coal, then, may be considered as occupying all the area included in the Coal Measures west of the great axis, a little distance from its eastern margin.

The center line of the great axis, if extended southward from Deer Park, in the same course it has from thence northward in the county, would strike the southeast corner of section 32, township 31, range 3 east. This is probably not far from the fact with regard to it. The Vermilion would cross it not far from the south line of section 15, township 32, range 2 east. At Vermilionville, and below, the dip is always southwesterly; while above this line of crossing, the general dip observed was always southeasterly.

The southern dip of the formations below the Coal Measures would carry them down until they were depressed enough to admit this bed on the east side of the great axis; and I think it possible that this bed may yet be found extending over township 31 north, ranges 4 and 5 east, a large part of township 32, range 5 east, and the southeast part of township 32, range 4 east, with patches of it northwest of this area, as far as a line drawn from Marseilles to where the Vermilion crosses into township 32, range 2 east.

The LaSalle Upper Bed—No. 42 of the section—like the lower bed, is quite regular, varying from four and a half to five feet in thickness, as usually found. Its area is co-extensive with the Coal Measures west of the great axis, except a narrow marginal border along this line, and at its northern boundary. I do not suppose this bed will be found east of the Big Vermilion, above Lowell, unless in the southeast part of the county, occupying a smaller range than has been indicated for the middle bed. I have not learned of any boring within this range. The Peru shaft went through this

bed with three feet and eight inches of coal. A boring made near the center of section 11, township 12, range 2 east, reached coal at one hundred and ninety-eight feet, reported thirty-one inches thick. Another boring near, reached coal at one hundred and sixty-two feet, seven feet thick. No sections of the strata were obtainable, and no other data given than above. This is probably No. 46 of the section, and I presume is the extension of the Kirkpatrick coal to the main body.

Quality of the Coal.—Of the coals mined at LaSalle and vicinity, the most popular in the market is the middle bed. The upper bed is a lighter coal, dry, free burning, with an open fire, and is a good steam coal, but consumes more rapidly than either of the others. It is a little harder to mine than the middle coal, and has some pyritous bands running through it near the top, which produce inferior coal. The mining of this bed is almost suspended.

The middle bed, from which the chief source of supply is derived, makes a denser fire; is also a good steam coal, largely used on the Illinois Central and Northwestern Railroads for locomotives, and is the popular coal for domestic use; also used in blacksmithing, by selecting it. It is mostly mined with powder, without undermining with the pick. In burning it lasts longer than the upper bed in an ordinary fire. The glass companies use it in preference to the lower coal, owing to its making a fire better suited to their work, and more economical than the lower coal, from the manner in which they burn it. It is a tolerably pure coal, has but little pyrites, and that in stratified bands, easily removed in mining. It often carries a band of cannel coal on top, from three to eighteen inches in thickness, which is of sufficiently good quality to be marketed with the rest.

The lower coal is the most highly bituminous of any of the beds, cakes in burning, and throws off a dense flaky soot, like Pittsburg coal; lasts longer in burning, and appears to be a stronger heating coal, if properly burned, than either of the others. It is an excellent coal, but has one drawback in having pyrites disseminated in very thin shales in the vertical seams, which can not be removed in mining, but, if very carefully selected, is an excellent blacksmith coal.

I think, if properly managed, it will produce a fine quality of coke, and the sulphur got rid of in the process, which will then make it suitable for iron furnaces. The large mining companies at LaSalle have not given this coal the attention it merits at their hands. By coking this coal carefully, an article of fuel for domestic

use can be obtained which would supersede the great demand in Chicago for anthracite coals, and can be furnished at much less cost. People long accustomed to the cleanliness of anthracite, do not like to use bituminous coals, and hence, while they can afford it, will use the former. A superior article of coke, at a fair price, would meet the wants of the community in this respect, and gradually be accepted in place of the other. The current price of this coal in the market is fifty cents per ton more than the middle bed.

The Streator coal appears to range between the middle and lower coal in its quality, as it does in geological position; but on account of its greater freedom from sulphur, it may take a rank in the market above the lower coal, for such uses as require greater purity in this respect. It has but recently been introduced into the general market, though long known locally for its superior merit as a blacksmith's coal.

Trenton Limestone.—Except in two localities, the entrance to Deer Park, and on the Big Vermilion, at Lowell, the exposures of this limestone do not exceed twenty-five feet in thickness, and are of the lowest beds. These lower beds, wherever seen in the county, are quite uniform in character, dolomitic, becoming siliceous at bottom, and in every exposure, but that at Lowell, the connection with the St. Peters sandstone below may be seen. They are argillaceous and thin-bedded, those joining the St. Peters being quite siliceous. None of these lower beds are fit for good lime, but answer a good purpose for common building stone, for which they are quarried at several points.

At the railroad tunnel, a mile and a half east of LaSalle, the beds are too much covered to have value for quarrying. The dip at this point is about 40° to the southwest. From thence southward, in crossing the valley of the Illinois river, the Trenton is covered with the alluvium of the valley, and it does not appear in the bluff on the south side.

At the entrance to Deer Park is an exposure of all the lower beds of the argillaceous qualities, gradually changing in the higher beds to a good quality of stone for burning white lime. The full thickness exposed here was not measured, and is estimated at about seventy-five feet.

The entrance to Deer Park is through the Trenton limestone, which forms portals on both sides, until it abruptly terminates against the St. Peters sandstone, of which the walls entire of Deer Park are composed. This limestone, at this point, forms a barrier to the river, and gives it a sharp turn to the left. Continuing

southeasterly, the line of upheaval strikes the Vermilion at Big Bend, where it forms the bed of the river for a quarter of a mile. There are some exposures of it in the bluff opposite, on the eastern side, where the washes have cut through to it. In the northwest quarter of section 8, township 32, range 2 east, a small exposure of it appears in the bed of the river. A little higher up the river, in the southeast quarter of section 8, the greatest exposure of it in the county begins, rising from beneath the Coal Measures in the bed of the river, and forming its bed for a mile and a half. In the river bed, in the northeast corner of section 16, at low-water, could be seen a constant flowing of bubbles of petroleum, with ebullition of gas. This was nearly opposite Eaton's old mill. The new dam built at Lowell now keeps this covered with water, and conceals it from observation. This little exhibition of petroleum led the citizens to put down a boring for oil, on the bank adjacent, in the southeast corner of section 9, nine hundred and sixty feet deep. The section of the boring, as furnished to me, is as follows:

1.	After going through drift and clay forming the base of the Coal Measures	18 feet
2.	Limestone, Trenton	170 "
3.	Sandstone	20 "
4.	Soapstone, blue clay, probably	10 "
5.	Sandstone, St. Peters	600 "
6.	Blue limestone	40 "
7.	White marble (?); so reported	40 "
8.	Sandstone, with very hard flint	80 "

No. 5 is probably erroneous, and no doubt includes the Calciferous. The intercalation of clay No. 4 in the sandstone was not seen anywhere else in observations of exposures. It is probable that No. 3, marked sandstone, is the siliceous beds of the Trenton, at the junction with the St. Peters, and it may be reported here at too great a thickness. No. 4, I suppose to be the clay parting between the Trenton limestone and St. Peters. In the outcrops it was never found more than a few inches. The white marble was probably a light-colored limestone. This boring shows the Trenton limestone at this point to be one hundred and seventy or one hundred and ninety feet thick.

The only other point where this limestone was observed on the western side of the axis, is on the northwest quarter of section 22, township 34, range 1 east, on the farm of Archibald Long. It extended a little southward on the southwest quarter. This was about twelve feet of the lowest beds, showing connection with St. Peters, a parting of nine inches of blue clay between. It has been quarried some at this point.

By reference to the map, it will be seen that the Trenton is here expanded to the west, from a line continued parallel to the axial line, and separating the Trenton from the St. Peters. This I believe to be approximately correct, and is based upon data furnished by Mr. Dixwell Lathrop, of LaSalle, of borings showing very nearly the outcrop of the Coal Measures.

From section 16, township 34, range 1 east, northward, the boundary between the Trenton and St. Peters, indicated on the map as a straight line, is given as approximately correct. This seems to be quite probable, from the very regular and nearly straight line of the margin of the Coal Measures, at their junction with the St. Peters, extending from the vicinity of Deer Park, south of the Illinois river, to section 22, township 34, range 1 east, and the further fact that this line extended, would very nearly meet the outcrop of the corresponding relation of the Trenton with the St. Peters on Rock river, near Grand DeTour; and the Trenton is conformable with the St. Peters.

East of the anticlinal axis, the first Trenton beds to be noticed are at Homer and vicinity, in section 35, township 35, range 1 east; also seen along the Little Vermilion, extending into section 25, where they appeared to fade out to the northeast, and disappeared near the center of the section; but, at this point, the drift obscures everything, and the range for observation was too limited, locally, to determine this absolutely. Along the stream, it can be traced continuously from near the south line of section 35 to the middle of section 25, and to the west line of section 35, in the southwest part of the village. This rock is more extensively quarried here than at any other point in the county.

From a study of the St. Peters sandstone, as it appears on Fox river, showing an undulating surface, and the exhibitions there of these lower Trenton beds as isolated patches, I am disposed to regard this exposure at Homer as local, and left remaining after the general denudation of the drift movement. It is not assumed that the map exhibits this patch of Trenton entire, but only so much was delineated as could be fairly determined. It is possible it extends farther in a northwest direction. There was a boring made at Mendota, which would have passed through the Trenton if it extended that far; but no record of this was obtainable, and this evidence as to its extent in that direction is lost. Its western boundary on the Vermilion is clearly defined. From Minehart's quarry, on the west side of the river, to the one on the east side, the beds

rise so rapidly, and so little appears of it on the eastern side, that its extent southeast from Homer is probably not greater than shown on the map.

The next point where it was observed is on Covel creek, near its mouth, and extending up about one and a half miles, where it disappears under the Coal Measures, with which, at this outcrop, it is nearly conformable. It is here about twenty feet thick, and corresponds in appearance with the exposures elsewhere. Its junction with the St. Peters here is well defined. None was observed at any point farther east in the Illinois Valley. Ascending Fox river it was first noticed in the bed of the river, a few rods above, where the north line of section 31, township 35, range 5 east, crosses the river. Only a few of the lowest beds are found here; the actual thickness could not be measured, extending below the river bed. This occurs in a depression of the St. Peters.

Farther up the river, above Mission creek, on the northeast quarter of the northeast quarter of section 18, township 35, range 5 east, on the left bank, the lowest beds of Trenton form the bank, the top of St. Peters forming the bed of the river. On the opposite bank, a little higher up, the St. Peters sandstone rises from the river, capped with the Trenton lowest beds, and in less than one-quarter of a mile reaches an elevation of twenty-five or thirty feet. The Trenton here is fifteen feet or more in thickness. It has been opened and quarried, and some inferior lime burned. This soon disappears, and St. Peters forms the entire bluff, continuously on the right bank, close to the water, and on the left, some distance back from the river, to the sharp turn of the valley eastward, in section 5, same township. Soon after leaving this bend, ascending the river, the banks become low, and are no doubt formed by the top of the St. Peters.

On the northwest quarter of section 36, township 36, range 5 east, the Trenton appears again, and from this point, ascending the river, it appears to be continuous. Brodie's quarry, northeast quarter of the northeast quarter of section 19, township 36, range 6 east, in Kendall county, on the right bank of the river, is the next fair exposure of it, and here the formation dips north sixty-five degrees east, at the rate of one foot in ten or twelve. This quarry exhibits beds higher in the Trenton than any observed below on the river, and is in heavy layers. The quarry is well opened, and fifteen feet in depth.

A bed of clay in the Trenton here, four feet thick, was reported by Mr. Brodie, but no facility existed at the time for getting at it.

The working of the quarry was confined to beds above this clay. This quarry is about a mile and a half up the river, beyond the LaSalle county line. A little below this quarry, on the same side of the river, the St. Peters shows in the bluff, and a small exposure is reported on the left bank, half a mile above the quarry, and right in the direction of the dip. This shows a much greater undulation than any observed down the river. This is said to be the last exposure of sandstone, ascending the river.

From a consideration of the general aspects of the exposures of this formation, east of the great axis in this county, they appear to be local longitudinal troughs, in the St. Peters sandstone, leveled up with the lower beds of Trenton limestone, which remained undisturbed in these depressions during the drift movement, their extent in length not being determinable by any exposures. Other patches are probably concealed under the drift. From the general trend of the St. Peters and the Trenton, where exposed on Fox river and the south side of the Illinois, I think it probable that a line drawn through the center of section 9, township 32, range 2 east, and section 27, township 33, range 3 east, and continued across the Illinois river to the east side of the county, wonld represent very nearly the border of the underlying Trenton. North of the Illinois it would bear somewhat more northerly than the line. The beds on Covel creek appear to be a spur from the main body.

Fossils.—The fossils from this locality are *Lituites undatus, Maclurea Logani (?), Gonioceras anceps, Orthoceras fusiforme, Ormoceras Bachii, Cyrtoceras,* two species, *Endoceras annulatum, E. proteiforme, Vanuxemia, Ctenodonta, Petraia corniculum, Leptena sericea, Strophomena alternata,* and *Asaphus canalis.*

St. Peters Sandstone.—This formation, where it has its full thickness, is about one hundred and fifty feet. The artesian well at Ottawa shows it one hundred and seventy-one feet. It has an extensive exposure, and occupies an area of about one-third of the county. In the Illinois valley, from the town of Utica, on the north side, and from Little Rock, one mile east of the mouth of the Big Vermilion, on the south side, to within about two miles of Ottawa, bold perpendicular bluffs of this sandstone, from forty to one hundred and twenty-five feet high, wall in this valley; and from Utica on one side, and Starved Rock on the other, the whole bed of the valley eastward, to the valley of Fox river, on the north, and a mile and a half east of Ottawa, on the south side of the valley, its bed is formed of this sandstone.

The boundary between this and the Calciferous underlying it, as it appears on the north side of the Illinois valley, east of the axis, is on the southwest quarter of section 8, township 33, range 2 east, about three-fourths of a mile west of Clark's cement mill. At this point there is two or three feet of the lower part of this sandstone capping the bluff.

Eastward, it dips seventy-five feet in three-quarters of a mile. and then appears to be nearly level for the next five miles, dipping a little; then an increased dip is observable, which brings the top of the formation to the bottom of the valley at Ottawa, and in the southwest quarter of section 8, township 33, range 4 east, it finally disappears under the Illinois river. South of the Illinois, it is no where seen, except at Deer Park and vicinity, and a very little exposure of it associated with the Trenton limestone, in the northwest quarter of section 8, township 32, range 2 east. Buffalo Rock, in the Illinois valley, is an isolated elevation of this rock, capped with the lower part of the Coal Measures. This body of rock has resisted the eroding action of the water, that has cut out the valley on each side of it. A noticeable feature of this formation is its tendency to form canyons wherever it appears as a high bluff and a stream of water flows over it. The most interesting of these is one near Fishburn's, on section 25, township 33, range 2 east, and Deer Park, before described.

This sandstone forms the bed of Fox river in this county, excepting about one mile at the eastern side, where it enters the county. On the west side of the axis the exposures of it, besides Deer Park, and in the Big Vermilion, are at the tunnel, and along the Little Vermilion and Tomahawk.

At the road-crossing of the Vermilion, on the north line of section 23, township 34, range 1 east, the lowest beds of the sandstone appear about five feet thick, and are quarried for four feet, for cellar walls. A peculiarity of the stone here, is an infinite number of small vertical holes, about the size of a knitting needle.

The bottom four feet of this rock, wherever found in the county, makes a tolerably good common building stone. All the rest lack cohesion enough for this purpose. The piers of the Chicago and Rock Island railroad bridge at the Little Vermilion, were built of this rock, quarried in the bottom near Starved Rock. In the run back of Clark's cement mill, at Utica, the connection of the St. Peters with the Calciferous formation may be seen to the best advantage of any point observed. A thin blue clay, from one to two inches thick, separates them. This clay holds up the water which

drains through the sandstone, producing fine springs at this horizon, wherever exposed, with much sandstone above. At this point the water silicifies the mosses and lichens which grow immediately below, over the face of the Calciferous rocks.

The prevailing color of this rock is a dull-buff, but great bodies of it are found, on removing the surface, perfectly white. This is selected by the glass manufacturers for their use. In texture, the rock is very uniform from top to bottom, with an even grain; and away from old exposures, with little cohesion, except the five feet at the base. In getting it for economic purposes, it is shoveled like common sand, with the aid of a pick to loosen it.

Calciferous.—This has a special interest, as being the only outcrop of this formation within the State, and its area here is limited to from seven to eight square miles; besides, it contains some beds from which excellent hydraulic cement is made. Its upper surface, along the line of the axis, of which it forms the center, is quite uniform. The most northern exposure of it is on the Little Vermilion, in the west half of section 22, and the northwest quarter of section 23, township 34, range 1 east, where it can be traced for three-quarters of a mile above the river level. The greatest thickness is fifteen feet, and is the upper beds. In the bluffs on either side of the valley it is capped with St. Peters sandstone. Where the bluff is highest the covering sandstone is only five feet thick. A little south of this it is covered only with drift, and the Tomahawk affords some fine exposures of it for a mile. The Pequamsoggin, for one mile and a quarter, gives a continuous exposure of it, from the Illinois river bluff northward; and it is exposed in the north bluff of the Illinois river, for two miles. The best point of all for seeing the fullest section of it is in this bluff, on the southwest quarter of section 8, three-quarters of a mile west of Clark's cement mill. At this point are two slight undulations forming anticlinals. It was here the section given below was taken. It will be noticed, there are several beds of cement rock interstratified, of variable thickness, and not uniform quality.

On the south side of the Illinois it dips under the St. Peters, the latter forming the entire bluff, but the Calciferous is the surface rock over the whole width of the valley opposite to its exposure in the north bluff; and for its eastern boundary, extends from the eastern side of the town of Utica, southeast across the valley to near Starved Rock.

Section.

1. St. Peters sandstone; bottom 2 to 3 feet	3 feet		
2. Siliceous and cherty beds of limestone	12 "		
3. Siliceous limestone; oolitic	0 "	9 inches	
4. Limestone	1 "	3 "	
5. Sandstone; Calciferous	0 "	9 "	
6. Limestone	2 "	6 "	
7. Limestone, with some flints	4 "	6 "	
8. Sandstone; Calciferous	1 "		
9. Cement rock; good	1 "	3 inches	
10. Sandstone	1 "		
11. Shaly limestone and clay	0 "	3 inches	
12. Cement rock; impure	1 "	10 "	
13. Sandstone; Calciferous; good fire-stone, used for lining the kilns	3 "		
14. Cement rock; impure; breaks into small, irregular fragm'ts; worthless	2 "		
15. Flint	0 "	4 inches	
16. Cement rock; impure	0 "	2 "	
17. Limestone; arenaceous	0 "	10 "	
18. Cement rock; impure	2 "	10 "	
Cement rock; good	0 "	6 "	
19. Limestone; good quarry rock	4 "	8 "	
20. Sandstone; Calciferous	1 "		
21. Limestone; irregular masses and broken fragments	3 "		
22. Cement rock; upper two feet not first quality	6 "	9 inches	
23. Limestone, in beds of good quarry rock; somewhat arenaceous, and irregular quality	4 "	6 "	
24. Cement rock; impure	2 "		
25. Limestone	1 "	6 inches	
26. Cement rock; good	0 "	10 "	
27. Sandstone; Calciferous	1 "		
28. Limestone	1 "	2 inches	
29. Cement rock; fair quality	1 "	6 "	
30. Limestone, upper part siliceous	6 "		
31. Cement rock; good: full thickness not ascertained, as it extends below the bed of the railroad. It contains two bands of four to six inches impure rock	5 "		
	78 feet, 8 inches		

In the above section, the beds are separated by thin clay seams. The rock quarried by Mr. Clark is in the bottom, half a mile southwest of the railroad station. The beds are No. 22 of the above section, and are covered with two to four feet of siliceous limestone, the middle for one foot sometimes oolitic. The appearance of most of this four feet of covering is somewhat like burrstone. Its different appearance in the bluff is probably due to long exposure. In the quarry, the cement rock is separated from the main covering rock by a white, highly-crystalline sandstone, one-half to one inch thick, very hard.

The upper portion of this cement bed contains many crystallizations of some salt of lime; the middle portion has many concretions of sulphuret of iron, small; bottom one-third appears to be free from both. The whole is thin-bedded, in irregular laminations, approaching a cherty character in form. No fossils found.

Mr. James Clark & Son, the only manufacturers of hydraulic cement here, manufacture and export sixty thousand barrels annually. It is well known in the market, from Chicago to Central Iowa, and throughout this State.

Economic Geology.

The first shaft for systematic coal mining, that of the LaSalle Coal Mining Company, was finished in the spring of 1856. In the autumn of the same year, the Northern Illinois Coal and Iron Company, and the Peru Coal Mining Company, each commenced shafts, which were completed the following year. In 1865 and 1866, the Chicago Coal Company, the Illinois Valley Coal Company, and the Kenosha Coal Company, each put down a shaft.

The table below shows the location of each shaft, all in township 33, range 1 east, the coal to which it is sunk, and the depth from the top of the shaft to the top of the coal:

Company.	Location.	Upper Coal	Middle Coal.	Lower Coal.
LaSalle Coal Mining Company..	S. W. ¼ Sec. 11	198 feet.....	260 feet.....	.....
Northern Illinois Coal & Iron Co.	S. W. ¼ Sec. 14	175 feet 5 in..	232 feet.....	395 feet.....
Peru Coal Mining Company.....	N. W. ¼ Sec. 20	94 feet 5 in..	Not found...	354 feet 6 in.
Chicago Coal Company.....	N. W. ¼ Sec. 13	174 feet.....	221 feet.....	.....
Illinois Valley Coal Company....	S. E. ¼ Sec. 23	224 feet 2 in..	294 feet 3 in..	433 feet 3 in.
Kenosha Coal Company.....	S. E. ¼ Sec. 25	229 feet.....	283 feet.....	452 feet 2 in.

The difference in depth in these several shafts, to the same bed of coal, is due chiefly to the different points of elevation at which the respective shafts are located. The LaSalle Coal Mining Company's shaft begins at the top of the LaSalle quarry rock; the next three companies begin below it, and the last two begin above it. All these companies have the three beds of coal on their property, except, perhaps, the Peru Company. They missed the middle coal in passing the level for it in their shaft. I think it quite probable, however, that it would be found by drifting from the shaft at the proper level.

The railroad and water communication give LaSalle a peculiarly advantageous position for transportation facilities, which must eventually give this point the controlling influence in the coal trade of Northern Illinois; and these facilities, with the abundance of coal of qualities suited to the different wants, must at the same time tend to build up a great manufacturing city here. The beginning of this movement is the permanent establishment of a large zinc smelting works and rolling mill, for reducing the ores of Wisconsin, and of glass factories.

The Vermilion Coal Company, at Streator, have already an outlet for their coal by their railroad connection with the Illinois Central Railroad, at Wenona, and a prospective one by way of Ottawa and Fox river, by railroad extension in that direction.

The depth to their coal ranges from forty feet, near town, to one hundred and twenty-two feet, in an east and southeast direction. At the point of the main opening in a ravine, it is not more than twenty-five to thirty feet below the general level.

Some years ago mining was carried on for shipment to market from Marseilles, but is discontinued. The middle coal was mined. The lower coal has not been worked in this county east of the vicinity of Ottawa and Dayton, that I am aware of.

Minerals.—Copper has been found in the drift, noticed under that head. Lead ore may be occasionally met with in the higher beds of the Trenton limestone, but not in quantity to be valuable; besides, these beds have a very limited range of exposure. I took out a few ounces of galena from a vertical crevice at the dam at Lowell. The ironstones of the Coal Measures are not abundant enough to be valuable.

Building Stone.—The principal source of supply has been from the LaSalle quarries of the limestone, No. 10 of the general section of the county, and the lower Trenton beds. Both of these are thin-bedded, but furnish a good rock for common foundation work—some entire buildings are constructed of each of them—and the lowest bed of No. 10 furnishes a fair quality of dimension-stone, about nine inches thick.

The sandstone, No. 49 of the section, furnishes, in parts of it, a tolerably fair building stone for common cellar walls and similar uses. It is only exposed along the Big Vermilion, from Big Bend up the river, at intervals, to section 8, township 31, range 3 east, and along the Illinois bluffs, from Marseilles to Seneca. Another sandstone in the Coal Measures of the south part of the county, No. 11 of the section, near Streator, furnishes a good building stone. The upper beds of this sandstone, about two feet thick, were quarried and put into the piers of the railroad bridge at Streator.

The lowest four feet of the St. Peters sandstone is a good building rock wherever found outcropping. It hardens by exposure. I found a house of which the cellar was constructed of this eighteen years ago. It is used also for bridge piers. Some of the strata of the Calciferous also furnish a good common building stone.

Limestone for Lime—Is obtained from No. 12, at LaSalle, the lime rom which is shipped in considerable quantities on the railroads.

It is dark-colored, and used only for common work. A fine white lime could be made from some of the Trenton beds exposed at Deer Park and Lowell—the only places in the county. The former is probably the best place for this purpose within the area comprised by the adjacent counties, and being near to cheap coal and good transportation facilities, a permanent buisness could be established here.

Glass Sand.—The St. Peters sandstone furnishes the purest white quartz sand for glass-making, in the greatest abundance. These glass factories are in operation in LaSalle, Peru and Ottawa—one in each place—making window glass and bottles.

Hydraulic Cement.—The cement rock of the Calciferous has been already noticed, in referring to that formation. The only manufactory of it is at Utica. There are two beds outcropping in the north bluff of the Illinois, west of Utica, that are of excellent quality and workable thickness; besides, thin beds of equal quality, but too thin for working profitably.

Fire-clay.—The beds Nos. 43, 47 and 68, of fire-clay, are of good thickness for working. No. 43 has been found, so far as tested in shafts of one or two coal mines, to have too many small lumps of iron pyrites to be valuable. No. 47 is less reliable in its thickness, and not any better in quality. No. 68 is found tolerably free from these impurities, and has been largely used for some purposes. Kirkpatrick's pottery, on the Vermilion, near Lowell, works clay from this bed, obtained on the bank of the river near by. A large amount has been taken from the border of the Coal Measures, of this same bed, in section 20 and 21, south of Utica, and transported to Joliet, for making drain-tile. The zinc manufactures at LaSalle made thorough tests of all these beds for their purposes, and found that none would bear the high temperature sufficiently well that their retorts are subjected to in smelting ore, and they depend upon St. Louis for fire-clay.

Peat.—A peat-bog in the Illinois valley, west of Utica, in the north-east quarter of section 18, was found, by sounding, to be from three to ten feet in depth, and dried specimens from it appeared to be a first class article. Some discoveries east of Utica were reported, but no data obtained.

Miscellaneous.

Mineral Springs.—A number of Springs were found impregnated with sulphur and saline matter. One in the bed of Clark's run, at

the railroad crossing, a few rods west of the station at Utica, is in the top of the Calciferous, is slightly magnesian and sulphurous; several near the Sulphur Spring House, above Utica, are strongly impregnated with sulphur, some magnesian, and iron; one on the south side of the river, in the northeast quarter of section 30, opposite Buffalo Rock, contains chloride of sodium, in tolerably strong solution. A salt marsh is formed by it in the swales through which it runs to the river. It rises through St. Peters sandstone. At Lowell, one on each side in the river bed were noticed at low water; both were from the same crevice in Trenton limestone. These are now covered by back water from the new dam. They were slightly sulphurous and magnesian.

Gas Wells.—A curious phenomenon, in the northwest part of the county, is exhibited by some borings in the drift, producing gas in quantity sufficient to burn. One in the southwest quarter of the southwest quarter of section 32, township 35, range 1 east, at a depth of forty feet, after passing through blue clay, struck gravel, covered with a thin stratum of conglomerate or cemented gravel, with a strong emission of gas, which took fire by applying a light. No water appeared, and the water that was in the gravel above ran down and disappeared in this gravel bed, which appears to be the usual second gravel of the drift, and here lies, probably, directly on the Trenton limestone. Two other wells, bored north of Mendota, exhibited similar phenomena. In treating of the Trenton limestone, reference was made to an exhibition of petroleum, producing bubbles of gas in the river, near Vermilionville. This is probably the origin of the gas in these borings—from underlying Trenton beds; and the gas wells north of Mendota afford some evidence that the Trenton beds at Homer extend to Mendota, with increased thickness, or at least that the Trenton beds at Homer become thick enough to bring in the higher beds to the northward: and the gas may move a long distance with the water in the gravel bed. There is another possible solution: The lower LaSalle coal often emits gas in considerable quantities, when mined; and an outlying patch of this might exist in a depression of the St. Peters sandstone. Unless well covered with clay, such a coal bed would account for the same phenomenon. My impression is, however, that the gas originates in the Trenton limestone.

Artesian Wells.—In all that portion of the county north of the Illinois river, east of the great axis, good water in large quantity may be obtained by artesian wells of moderate depth; and in the south part of the county, east of the axis, or of the Big Vermilion,

at a gradually increasing depth in a southern direction. North of the Illinois river, water will flow over the top of a boring extending about three hundred feet below the top of the St. Peters sandstone. A less depth, near the axis, is where the St. Peters is thin. To this must be added the drift, ranging from a few feet to one hundred or more. South of the river the increased depth will be the increase of thickness of the Coal Measures, and a gradually increasing thickness of the Trenton, making, together, in the southeast part of the county, perhaps two hundred to two hundred and fifty feet.

The supply of water, as indicated by borings at Ottawa and Vermilionville, is from the Calciferous beds, and a sandstone below. It is possible that in some portions of the south part of the county water might rise to the surface from the bottom of the St. Peters.

Brush's well, in the valley in the north part of Ottawa, after passing through the St. Peters into the Calciferous, shows a sandstone at about three hundred feet, underlying the limestone beds, into which the boring was continued, until the well reached four hundred feet from the surface.

The record of the Ottawa well at the Court House was:

St. Peters	171 feet
Calciferous	139 "
Total	310 feet

No report was received of the boring below this point. Water flowed over at two hundred and eighty-six feet.

The Hitt well, in the southwest corner of the southeast quarter of the southeast quarter of section 24, township 33, range 2 east, beginning lower in the St. Peters struck water at two hundred and fifty-eight feet, which run over the top very strong. In this well the water contains considerable chloride of sodium, which comes in somewhere in the upper levels, as the water struck below was fresh, making the flow less saline after it was reached.

At the Vermilionville well, water was first noticed rising soon after striking St. Peters sandstone, and flowed over the top at a depth of about three hundred and eighty feet. This would be near the base of St. Peters. The flow increased for the next one hundred feet, after which no increase was noticed. This well is also somewhat saline.

The flow from all these wells is very strong. In cases where the water from these wells is saline, soft water may be obtained by tubing out the water above the lower sandstone.

In the prairie, north of the Illinois and east of the axis, a boring would need to be from four hundred to six hundred feet, according

to location and depth of drift, excepting near the axis, south of the north line of township 34, where a less depth probably would answer. In the prairie, south of the river and east of the axis, from five hundred to seven hundred, or seven hundred and fifty feet, according to location, would probably be required for a strong flow of water, the deepest being in the southeast part of the county.

CHAPTER XI.

CALHOUN COUNTY.

This county comprises a long, narrow belt of territory, lying in the forks of the Illinois and Mississippi rivers, extending about thirty miles from north to south, with an average width of about eight miles. Topographically, it may be described as a narrow limestone ridge, elevated from two to three hundred feet above the river level, and flanked on either side by the alluvial bottoms of the great rivers, which form its eastern, southern and western boundaries. Over this limestone ridge there has been subsequently deposited beds of Quaternary age, consisting of drift clays, gravel and loess, covering the whole surface to the depth of fifty to one hundred feet. These deposits also fill some of the lateral valleys which intersect the river bluffs, showing that these valleys existed anterior to the Drift epoch.

This county is bounded on the north by Pike county, on the east by the Illinois river, and on the south and west by the Mississippi. It embraces an area of a little less than seven townships, or two hundred and fifty-one square miles. It was originally a heavily-timbered region, the whole of the uplands and a portion of the bottoms being covered with a heavy growth of timber, embracing the usual varieties of oak and hickory, linden, elm, hackberry, sugar maple, black and white walnut, and honey locust; all of which are found on the uplands, while on the bottoms we find cottonwood, sycamore, ash, soft maple, coffeenut, hornbeam, pecan, willow, etc. The only stream of any importance in the county, besides the large rivers which form its principal boundaries, is Bay creek, which enters the county near the northwest corner, and after a southeasterly course of about ten miles, empties into the Mississippi about three miles above Hamburg.

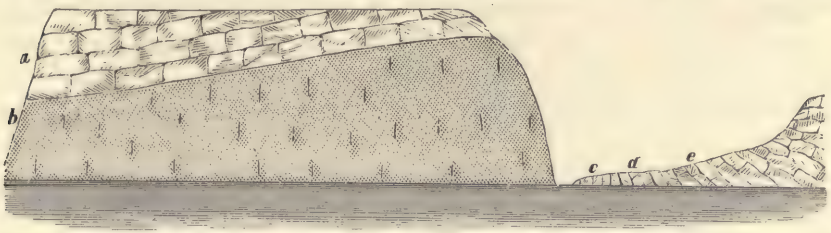
The upland region in this county is quite hilly, and some of it is too broken for cultivation, though the soil is productive, and yields abundant crops of all the cereals and fruits usually cultivated in this climate. The heavy deposits of drift clay and loess that overlie the stratified rocks, determine the general character of the soil, which is but slightly affected by the older formations, except on the steep slopes of the hills, where the limestones and sandstones come to the surface, and, by their decomposition, have modified to some extent the soil above them. The marly clays of the loess form the soil and sub-soil over a large portion of the uplands, while the bottoms are covered with a sandy loam, similar in character to that of the principal alluvial valleys of the west.

The geological structure of this county is exceedingly interesting, both from the wide range of formations exposed within its limits, and also from the disturbing influences to which the older strata have been subjected. The *great fault*, which crosses this county below *Cap au Gres*, is the most remarkable disturbance of the stratified rocks to be found within the limits of the State, and to this disturbance is due the wide range of geological formations that appear within the area of this county, comprising the whole range of paleozoic strata, from the St. Peters sandstone of the Calciferous period to the Coal Measures, and including something over a hundred feet in thickness of the latter group, a wider stratigraphical range of formations than is found in any other county in this portion of the State. This fault intersects the Mississippi bluffs immediately below the high cliff of St. Peters sandstone, to which the name *"Cap au Gres,"* or *Sandstone Headland*, was given by the French *Voyageurs*, and with a trend of east 10° south, it intersects the bluffs of the Illinois about two miles below Monterey, crosses to the bluffs on the eastern side of that stream, about five miles above its mouth, and after intersecting an elbow of the river bluff in Jersey county for three or four miles, it is finally lost in the valley of the Mississippi. The strata have not only been dislocated by this disturbance, but there has also been a downthrow of the beds, to the extent of at least seven or eight hundred feet on the western side of the fault, while on the east they remain but slightly elevated above their original horizontal position, and are seen dipping gently to the northeastward.

To the northward of this axis, the Burlington limestone forms the bed rock at the summit level of the dividing ridge between the two rivers, up to, and beyond the Pike county line, while to the southward nearly all the highlands are directly underlaid by the St. Louis

limestone or the Coal Measures. The exact line of this fault is hidden in the valley of a small stream, which enters the Mississippi just below the *Cap au Gres* bluff, but immediately below this valley the lower Carboniferous limestones are seen standing in a nearly vertical position, dipping southward 10° west.

The following wood cut will serve to illustrate the relative position of the strata at this point, showing the *Cap au Gres* bluff of the lower Silurian strata on the left, and the up-turned edges of the lower Carboniferous limestones immediately below it on the right:



a.—Trenton limestone. *c.*—Burlington limestone. *e.*—St. Louis limestone.
b.—St. Peters sandstone. *d.*—Keokuk limestone.

We are unable to fix the exact period when this disturbance took place, but it seems to have been anterior to the Coal epoch. This is indicated by the unconformability of the coal strata to the underlying limestones on the north side of this axis in Pike and Adams counties, where the Coal Measures rest unconformably on the Keokuk and Burlington limestones, showing that these beds had been elevated, and a considerable thickness of strata removed by denudation, before the deposit of coal. Southwest of this axis, the coal rests on the St. Louis limestone, but whether exactly conformable to it or not, we cannot say, from the partial exposures we were able to examine.

The following section exhibits the different formations that may be seen in this county, showing their relative positions and thickness. This section presents a thickness nearly equal to one-half of all the stratified rocks found in the State, and, with the exception of the middle and upper Coal Measures, and the Chester group of the lower Carboniferous limestone series, it comprises all the important divisions of the paleozoic strata to be found in the State:

	Feet.
Loess	40 to 60
Drift, clay and gravel	10 to 20
Coal Measures	100 to 120
St. Louis limestone	200
Keokuk group	150
Burlington limestone	200

	Feet.
Kinderhook group	120
Hamilton limestone	6 to 15
Niagara limestone	50 to 75
Cincinnati group	80 to 120
Trenton limestone	350 to 400
St. Peters sandstone	150
Maximum thickness	1,630

The St. Peters Sandstone.—This is the oldest rock appearing above the surface in this county, and its only point of outcrop is at the *Cap au Gres* bluff, on section 30, township 12 south, range 2 west. It forms the lower escarpment of this bluff, which is about a mile in extent on the river, but it dips strongly to the northeastward, and disappears below the succeeding formations so rapidly that it is nowhere seen except at this point. The lowest portion of the bed does not appear above the surface, but there is about one hundred and fifty feet in thickness exposed at the lower end of the bluff, which gradually passes beneath the magnesian beds of the Trenton group towards the upper extremity, making its entire outcrop along the river a little more than a mile in length. It is a purely siliceous rock, made up of minute grains of quartz that are sometimes scarcely cemented at all, and some portions of it readily crumble to sand on exposure. Other portions of the mass are tolerably well cemented by the infiltration of the oxide of iron, and the rock then forms a bold mural precipice along the river bank. A section of this bluff, made nearly midway between its northern and southern extremities, shows the following order:

	Feet.
Loess capping the bluff	60
Light-gray Trenton limestone	8
Brown and buff magnesian limestone	70
St. Peters sandstone	130

The sandstone is irregularly stratified, and often concretionary, showing no well defined lines of bedding. It may be regarded as the equivalent, in part, of the Calciferous group of New York, and corresponds to the Saccharoidal sandstone of Missouri. No organic remains have yet been found in it, either in this State or elsewhere.

Trenton Group.—This group, as it is developed in this county, consists of brown and buff magnesian limestones at the base of the series, which attain a thickness of about seventy feet. These are succeeded by fine-grained, compact, gray and chocolate-brown limestones forming the middle division of the series, and these are overlaid by a rather soft, coarse-grained, yellowish-gray limestone, forming the upper division of the group. Its aggregate thickness

may be estimated at three hundred and fifty to four hundred feet. Its most northerly outcrop in this county is at the foot of the Mississippi bluffs, about three miles below Gilead P. O., on the northeast quarter of section 31, township 11, range 2 west, though it was found only about three feet below the surface in digging a well on the southwest quarter of section 29, in the same township. The rock where it first appears in this vicinity is a light yellowish-gray coarse-grained limestone, rather soft and very uneven in texture, and weathers on exposure with an uneven and ragged surface. It is rather thin-bedded at the top, but becomes more massive below, and the strata rise in a southerly direction so rapidly that about two miles below the point where the rock first appears it forms a perpendicular cliff from eighty to a hundred feet in height. A few fossils were obtained from these coarse-grained limestones, among which were *Strophomena alternata*, *Orthis lynx*, and a ramose form of *Chætetes*. Below this coarse-grained limestone we find about fifteen or twenty feet in thickness of fine-grained, chocolate-colored, thin-bedded limestone. It weathers to an ash-gray color, and the strata are generally from two to four inches in thickness.

Descending along the river bluffs below the outcrop of these limestones, we find them underlaid by a series of light-gray, compact, fine-grained limestones, partly thin-bedded, but affording some massive strata in the lower part of the series. These limestones continue to form the main portion of the river bluff down to the small creek which intersects the bluffs just above the *Cap au Gres* ferry landing. At this point the upper layers of the brown and buff limestones, which form the lower division of the group, are seen just above the creek level.

On Cave Spring Branch, a small creek which intersects the bluffs about a mile and a half above the ferry landing, the upper portion of the Trenton limestone is well exposed, forming the bed and bluffs of the creek for a mile or more from its mouth. The thin-bedded, chocolate-colored limestone is also well exposed on this creek, and is here quite arenaceous, and passes into a fine-grained calcareous sandstone. Some of the light-gray compact limestones below this chocolate-colored bed are filled with marine plants, or *fucoides*, which are well exposed on the weathered surfaces of the rock. Trilobites are not uncommon in these limestones, and fragments of *Asaphus megistos*, *Ceraurus pleurexanthemus*, and *Illænus ovatus* were obtained here. They are associated with two or three species of *Orthoceras*, and the common Brachiopoda of this horizon.

The lowest division of this group consists of evenly-bedded buff or brown dolomitic limestones, which attain a thickness of about seventy feet, and are seen overlying the St. Peters sandstone at the upper end of the *Cap au Gres* bluff, the only point where they are found well exposed. The beds vary in thickness from four inches to two feet or more, and the dip is so strong to the northeastward that this division of the group only outcrops over a very limited area, in the immediate vicinity of the river bluffs. Indeed, the whole of this group, nearly or quite four hundred feet in thickness, covers, in its outcrop in this county, an area of only about three or four square miles.

Cincinnati Group.—The Trenton limestone is immediately overlaid in this county by blue and green, partly indurated clays, which attain an aggregate thickness of about a hundred feet, and although they have afforded no fossils, their stratigraphical position and lithological characters are sufficient to determine their position in the geological series, as the equivalents of the Cincinnati group of our general section of the Illinois strata. These clays are seldom found well exposed, but partial outcrops are occasionally seen on the slopes of the hills, either on the small streams or gulches which intersect the river bluffs along their line of outcrop. They are often met with in digging wells in the region which they underlie, and where the upper Silurian limestone is wanting, this group forms low rounded hills or gentle slopes, that seldom afford any good exposure of the underlying strata, although they may be but a few feet beneath the surface. Their first appearance on the eastern side of the county, on descending the river bluffs, is between Hamburg and Gilead, where they are occasionally seen cropping out beneath the Niagara limestone, which here forms the upper part of the bluff. When exposed at the surface, they form a tough, blue plastic clay, very much like the potter's clays of the coal formation. On the northwest quarter of section 19, township 10, range 2 west, they outcrop beneath the Niagara limestone, and extend down to the river level and below, showing a thickness above the river of about forty or fifty feet. Gradually rising in a southerly direction, they are found in the vicinity of Gilead about one hundred feet or more in thickness, but seldom well exposed. From this point their outcrop trends southeastwardly across the county, following the direction of the *Cap au Gres* fault, and appearing in the Illinois river bluffs, on the eastern side of the county, in the vicinity of Monterey, where they form the base of the bluff and are overlaid by the Niagara and Hamilton limestones. From this point northward, they are occa-

sionally seen at the base of the bluffs for two or three miles, when, with a gentle northeasterly inclination, they pass below the level of the Illinois bottoms, and are seen no more. No calcareous or arenaceous strata were found associated with this group in this county, and it appears to be composed entirely of fine argillaceous sediments.

Niagara Limestone.—This is one of the most important formations in the county, and is well exposed at many points in the river bluffs, on both the east and west sides of the county. On the west, it appears at the base of the bluff, near the north line of the county, forming a low bench of light-gray limestone, from fifteen to twenty feet above the river level, and thence extends down nearly to the mouth of Bay creek, where, by an undulation of the dip, it sinks below the level of the river, and does not appear again above Hamburg. At that point it again rises above the river level, and at the mouth of the small creek, which enters the river on the lower side of the village, there is an outcrop of the upper part of this formation, about twenty feet in thickness, over which the creek forms a cascade just above its mouth. The rock is here a compact bluish-gray limestone in regular beds, from six inches to a foot in thickness. It has a moderate dip to the northward, and half a mile below this point, where another creek enters the river, a measured section showed about forty-five feet of this limestone above the river level. At all the localities where this formation was seen, from the north line of the county to a point some two miles below Hamburg, the rock is of a bluish-gray color, and usually even bedded, but south of this, it changes to a light-brown or buff color, and presents the characters of a true dolomite. In the vicinity of Hamburg it is immediately overlaid by a brownish-gray, arenaceous Devonian limestone, and this is succeeded by the limestones and shales of the Kinderhook group. The following section will show the relations of these different formations as they appear in the vicinity of Hamburg, including all, to the highest point of the bluff:

	feet.
Loess forming the summit of the bluff	60
Burlington limestone	40
Shaly ash colored limestones (Kinderhook)	40
Greenish sandy and argillaceous shales (Kinderhook)	60 to 70
Slaty oolitic limestones (Kinderhook)	10 to 15
Fine grained light blue limestones (Kinderhook)	4 to 20
Green shale (Kinderhook)	1 to 3
Hamilton limestone (Devonian)	4 to 8
Niagara limestones (Up. Silurian)	40 to 50

The Niagara limestone extends below the river level at all the exposures in the vicinity of Hamburg, and its entire thickness is not seen. On the northwest quarter of section 19, township 10 south, range 2 west, the rock was quarried for the jail at Hardin. At the base of this formation here, where it rests on the blue clays of the Cincinnati group, we find from two to four feet of light-gray oolitic limestone forming the lower beds, which are overlaid by the buff and brown dolomitic limestones in which the quarries for building stone were opened. These beds are here about fifty feet in thickness, and probably comprise nearly the whole thickness of the Niagara group at this point, for on the adjoining section, on the small creek which intersects the bluffs on section 18, township 10 south, range 2 west, the Hamilton limestone is found in place overlying the upper Silurian strata.

From this point south, to a point a mile below Gilead, these limestones continue to show themselves in occasional outcrops, forming the upper portion of the bluffs, while below, there is a sloping talus, underlaid by the blue argillaceous clays of the Cincinnati group. Below Gilead, the line of outcrop of the Niagara limestone and overlying formation recedes from the river bluffs, and is found in the hills from one to two miles back, towards the interior of the county. It continues in a southerly direction to section 28, township 12 south, range 2 west, where its trend is changed to the eastward across the county, by the disturbing influences that caused the *Cap au Gres* fault.

Its most southerly outcrop on the eastern side of the county is in the vicinity of the Stone Church, two miles below Monterey, where about twenty feet in thickness of buff limestone is exposed, and has been quarried for building stone in this neighborhood. Between this point and Monterey this limestone is mostly hidden under the overlying lower Carboniferous formations. At Mr. C. W. Twitchell's place, on the southeast quarter of section 10, township 12 south, range 2 west, this limestone has been quarried, where it forms a precipitous bluff some forty to fifty feet high.

At the point of the bluff above Monterey on the Hardin road, on the northeast quarter of section 11, in the same township, the following measured section was obtained:

	Feet
Hamilton limestone	12
Buff colored Niagara limestone	50
Covered slope with partial outcrops of blue clays	48

The blue clays forming the lower part of this section undoubtedly belong to the Cincinnati group, and though the junction of the

upper and lower Silurian strata could not be seen here, it is probable that nearly the full thickness of the Niagara limestone is represented in the above section, as this is about its average in this part of the county. From this point northward along the bluffs of the Illinois river, the brown and buff limestones of this group continue, in occasional outcrops at the foot of the bluffs, for about six or eight miles, when the color of the beds change to a bluish-gray, very much like the beds in the vicinity of Hamburg, and from thence northward, only a few feet in thickness of the upper part of this formation is seen. A half mile above Hardin, there is about twenty-five feet of the upper part of this formation exposed above the level of the river at low-water, consisting of rough, irregular bedded, bluish-gray limestone. From this point northward, to the small creek which empties into the Illinois about three-quarters of a mile below Farrowtown, we find occasional outcrops of the upper part of this limestone, and on this creek, which is the most northerly outcrop known on this side of the county, there is about ten or twelve feet of the upper part of this group exposed, consisting of even-bedded, fine-grained limestone, that may be seen for a distance of two or three hundred yards to the westward of the road. But few fossils were to be obtained from this formation in this county, though the beds in the vicinity of Monterey seem to be quite as fossiliferous as this rock usually is in this portion of the State, and when the quarries here are worked to any considerable extent, as they now are at Grafton, they will, no doubt, afford a good many interesting forms of organic life.

Hamilton Limestone.—This is the only division of the Devonian system that has been identified in this county, and consists of from six to twelve feet of brownish-gray limestones, that are usually very hard and siliceous, and sometimes pass into a coarse quartzose sandstone. At the most northerly outcrops of the Niagara limestone in this county, there seems to have been no development of the Hamilton beds, and the upper Silurian limestones are immediately overlaid by the shales and limestones of the Kinderhook group.

On the west side of the county, the first exposure of this limestone met with, below the north line of the county, was on the northeast quarter of section 20, township 8 south, range 3 west, where a stratum of white sandstone, about a foot in thickness, was found resting upon the Niagara limestone. No fossils were obtained from the sandstone at this locality, but further south a similar sandstone abounds in the characteristic fossils of this group, leaving no doubt as to the age of these arenaceous strata. In the bed

of the small creek which enters Bay creek about five miles above Hamburg, there is about six feet in thickness of coarse brownish-gray limestone exposed, filled with characteristic Devonian fossils, among which are two or three species of *Spirifers, Atrypa reticularis, Orthis Iowensis,* and several of the common corals of this group, among which were large masses of a coral which has usually been referred to the genus *Acervularia,* and has been called *A. Davidsoni.** At an old mill, a short distance below this point, these thin-bedded limestones were eight feet in thickness, and were overlaid by two feet of green shale, which was succeeded by the fine-grained light-blue limestone of the Kinderhook group.

At Hamburg this limestone is also exposed, and is about six feet in thickness. The upper layers are quite arenaceous, and pass locally into a quartzose sandstone. From this to Gilead, this limestone was met with at every locality examined, where its proper horizon could be seen, and its characteristic fossils are frequently met with, weathered out on the sloping hill-sides below its outcrop. Just below Gilead its outcrop trends eastwardly, leaving the river bluffs, and it was next seen a few hundred yards to the eastward of the *Salt Spring,* on section 16, township 11 south, range 2 west. In this vicinity it is quite siliceous, and passes into a sandstone, which is filled with beautiful siliceous casts of some of its most characteristic fossils. I am indebted to Mr. Wm. McAdams, of Otterville, Jersey county, for some of the fossils of this sandstone, obtained in the vicinity of the *Salt Spring.*

The most southerly point where we found this limestone exposed on the eastern side of the county, is on the southeast quarter of section 11, township 12 south, range 2 west, just above Monterey, where it caps a bluff of Niagara limestone. It is here quite siliceous and thin-bedded at the top, but becomes more massive below. At Mr. Belt's place, near the north line of section 35, township 11, range 2 west, we found this limestone well exposed, and a quarry opened in it, on our first visit to the county in 1853. The bed is here about twelve feet thick, and the rock is quite evenly-bedded, the layers generally ranging from four inches to a foot in thickness. It abounds in fossils, among which are *Spirifer Wortheni, Atrypa reticularis,* and several species of *Zaphrentis* and *Heliophyllum.* From this point northwardly, this limestone may be seen outcropping along the base of the bluff, nearly to the north line of town-

*On referring this coral, DR. ROMINGER, of Ann Arbor, Michigan, one of our best authorities on fossil corals, has pronounced it a true *Cyathophyllum.*

ship 10 south, range 2 west, beyond which point it was not seen. A half mile above Hardin, it is found overlying the Niagara limestone, the latter formation occupying the lower twenty feet or more, above the river level. It is here about eight feet in thickness, the lower portion quite thin bedded, but becoming, at the top, a hard gray limestone, in thicker strata. Fossils are quite abundant here, especially corals, which are found weathered out of the limestone, and are mingled with the debris composing the shingle of the river bank. This limestone is closely associated with the Niagara group, which it immediately overlies in this county, and its outcrop is entirely restricted to localities where the Niagara limestone also appears above the surface.

Kinderhook Group.—At the base of the lower Carboniferous series in this State, we find a group of rocks, mainly sedimentary in their origin, consisting of shales, shaly sandstones and thin beds of limestone, but locally becoming quite calcareous, and passing into thin bedded ash-colored shaly, and magnesian limestones. At some points in this county, the upper portion of this group is represented by thin bedded ash-colored shaly limestones, the equivalent of the *Choteau limestone* of the Missouri report, which are underlaid by sandy and argillaceous shales, with thin beds of oolitic, and fine grained limestone at the base. The following section, made in the vicinity of Hamburg, will show the average thickness, and order of succession, of the various beds of this group:

	Feet.
Thin bedded shaly limestones	30 to 40
Sandy and argillaceous shales	40 to 50
Oolitic limestone	3 to 10
Fine grained, light blue or dove colored limestone	4 to 12
Green shale, sometimes partially bituminous	2 to 15

These beds are seldom well exposed in this county, as they underlie the Burlington limestone, which generally forms the upper escarpment of the bluffs, and they are consequently mostly hidden under the sloping talus beneath. From the north line of the county to Hamburg on the west, and to the south line of township 11 south, range 2 west, on the eastern side of the county, this group may be found in partial exposures either in the face of the bluffs below the perpendicular limestone escarpment, or in the ravines by which the bluffs are intersected. In the vicinity of Hamburg this group is well exposed in the banks of the small creek just below the village, showing exactly the order of succession to be seen in the above section. The green shale at the base of the group rests directly upon the Hamilton limestone, and may be the representative of what has sometimes been called the "Black slate" formation,

but in the absence of any evidence that it is of Devonian age, we have included it in this group, with which it seems to be identified more closely than with the beds below. Above this we find the light bluish-gray siliceous limestone, sometimes called the "Lithographic" limestone, which is variable in its thickness in this county, ranging from four to twenty feet. A few fossils were obtained from this rock in the vicinity of Hamburg, among which were *Productus pyxidatus*, *Spirifer Marionensis*, *Cyrtia acutirostris*, and an *Orthis* like *O. Michelini*. On the eastern side of the county, we did not find this limestone exposed. It received the name of "Lithographic" limestone from its resemblance to the stone used in lithography, but some examples of it which have been tested for that purpose, have not shown the necessary qualities of a good lithographic stone. It is regularly stratified, in beds varying from two inches to a foot in thickness, but the strata are intersected by numerous seams and cross fractures, so that good slabs of any considerable size are not easily obtained. This character alone would render it unfit for the lithographer. This limestone is succeeded by a thin bedded oolitic limestone, which, in the vicinity of Hamburg, ranges from five to ten feet in thickness, and splits readily into thin layers of an inch or less in thickness. A portion of it is quite fossiliferous in the vicinity of Hamburg, and has afforded the following species: *Rhynchonella pustulosa*, *Spiriferina subtexta*, *Leda Barrisi*, and a *Terebratula* resembling *T. hastata*.

On the eastern side of the county we found an oolitic rock exposed on Mr. Whitaker's place, northwest quarter of section 27, township 8 south, range 2 west, which probably should be referred to this horizon. The lowest rock seen at this point is a blue argillaceous shale, with some thin layers of limestone strongly impregnated with the sulphuret of iron. This shale was overlaid by a bed of oolitic conglomerate, closely resembling that found at Rockport, in Pike county. It is here from four to five feet in thickness, one-half of which constitutes but a single layer, and the remainder is in thin beds, from two to six inches thick. This was the only point where we found it exposed on the eastern side of the county.

These oolitic beds are generally succeeded by argillaceous and sandy shales, which vary in thickness from forty to eighty feet, and are argillaceous at the base and arenaceous at the top, passing into shaly gritstones. These beds contain but few well marked fossils in this county, except a large fucoid, like the *Cauda Galli* of the New York Corniferous beds, which is quite abundant in the shaly gritstones of this group. Its occurrence in these beds has been urged

as an evidence of the Devonian age of this formation, but a similar fucoid is found high up in the Coal Measures in Illinois, and hence no satisfactory conclusion as to the age of any formation could be predicated upon the occurrence of this peculiar fossil in it. At Reed's Landing, in the northeast part of the county, this fucoid is quite abundant in the thin gritstones which form the upper portion of the group in that vicinity.

At Hamburg the upper beds of this group become calcareous, and form an ash-gray shaly limestone, twenty-five to thirty feet or more in thickness. Some of the beds are magnesian, and partly concretionary in their structure, and contain a few fossils, among which are *Strophomena analoga*, *Euomphalus latus* and *Productus semi-reticulatus*. It may be that these magnesian and shaly limestones are the stratigraphical equivalents of the lower division of the Burlington limestone, but they contain very few crinoidal remains here, and these are generally too fragmentary to be specifically determined.

About three-quarters of a mile north of Brussels there is an outcrop, just above the level of the Illinois bottoms, of a striped purple and green oolitic conglomerate. The quarry exposes about four feet in thickness of the rock, which lies in thin beds from two inches to a foot in thickness. It is overlaid by about three feet of fine-grained limestone, apparently the equivalent of the so-called "*Lithographic*" limestone of the Kinderhook group. No similar rock has been found anywhere else in the State, and we are only able to determine the horizon to which it belongs from its connection with the overlying limestone. From its association with that limestone, we refer it without hesitation to this group, and consider it as probably replacing the green shale which forms the base of the group at nearly all the other localities where we found the lower beds exposed in this county. This is the only point south of the *Cap au Gres* axis where we met with any exposure of the Kinderhook beds in the county.

Burlington Limestone.—This division of the lower Carboniferous series outcrops over a wide area in this county, and forms the bedrock over nearly all the highlands north of the *Cap au Gres* axis. It forms the upper escarpment of the river bluffs from the north line of the county to Hamburg on the west, and to the vicinity of Monterey on the east, and also outcrops on most of the small streams in the northern part of the county. Its entire thickness ranges from one hundred and fifty to two hundred feet, but it is

usually only partially exposed, a considerable portion of it being hidden, either in the covered slope at the top of the bluff, or in the sloping talus below.

At Reed's Landing, about two miles and a half below the north line of the county, the bluffs of the Illinois are about two hundred and forty feet in height, nearly one-half of which is Burlington limestone, forming a natural cliff a hundred feet or more in height. Below the limestone cliff there is a sloping talus to the level of the bottoms bordering the river, covering the shales of the Kinderhook group, which probably extend from the base of the limestone down to the river level. This limestone is generally coarse-grained or granular in texture, of a gray or brownish-gray color, and tolerably regular-bedded, the strata varying from four inches to two feet in thickness. It contains a good deal of cherty or flinty material, which occurs either in nodules or in regular seams intercalated in the limestone strata. The term "*Crinoidal limestone*," which has sometimes been applied to this rock, is very applicable to the upper portion of it in this county, as it is almost entirely composed of the remains of crinoidea and other marine animals, cemented by calcareous matter. The chert with which the limestone abounds is also filled with the silicified remains of these marine animals, and it affords exquisite casts, in flint, of the internal structure and markings of many of the organic bodies of which this limestone is so largely composed. Casts of several species of *Actinocrinus*, one species of *Platycrinus* and *Granatocrinus Norwoodi*, were obtained from the chert nodules at this locality, and from the limestone we obtained *Spirifer Grimesi*, *Strophomena analoga*, and *Euomphalus latus*. The lower portion of this limestone here, as elsewhere in this county, consists of alternations of gray and light yellow or brown, earthy or magnesian limestone, only slightly crinoidal in its character, but finer grained and more compact than the upper beds. It contains very few well preserved crinoids, though detached columns and crushed bodies are frequently met with. In some respects these brown beds would seem to correspond to the lower division of this formation at Burlington, Iowa, but the fossils obtained here are too few and imperfect to enable one to identify the strata with those at more northern localities, where fossils are abundant and well preserved. From Reed's Landing to Farrowtown this limestone forms a continuous cliff, except where it is intersected by the valleys of the small streams, the bluffs ranging from two hundred to two hundred and fifty feet in height.

These bluffs continue, with but slight interruption, to Hardin, where they are fully two hundred and fifty feet in height, the upper escarpment being formed by the lower portion of the Burlington limestone, the sloping talus below covering shaly limestones and shales of the Kinderhook group, while near the river level we find the upper portion of the Niagara limestone overlaid by the Hamilton.

The following section shows the thickness and order of succession of the beds forming the bluff a half mile above the town:

		Feet.
Loess capping the bluff		30 to 40
Burlington limestone		70 to 80
Kinderhook	Thin-bedded limestone and shale	80 to 85
	Slaty limestone	10
	Fine-grained, light-blue limestone	5
Hamilton limestone		8 to 10
Niagara limestone		20

These beds are mostly hidden beneath the sloping talus of the bluff, except the upper and lower limestones, the former outcropping at the top of the bluff and the latter on the river bank, and on the small creeks by which the bluffs are intersected.

Following down the river bluff, below Hardin, these beds continue, but with slight variation, to the south line of township 11 south, range 2 west, where the high bluffs terminate on the eastern side of the county. At Mr. Belt's place, about three miles above Monterey, the following measured section was made in 1853, on our first visit to this county:

	Feet.
Loess capping the bluff, not measured.	
Burlington limestone	50
Shaly ash-gray limestone	95
Blue clay shale	18
Hamilton limestone	12
Slope covering Niagara limestone	40

Two miles below this the Burlington limestone disappears for about two miles, and the bluffs, which are comparatively low, are formed by the older formations, but a mile below Monterey it comes in again, capping the bluff for a short distance, with a strong dip to the northeastward from its proximity to the *Cap au Gres* axis. It extends down to the southeast quarter of section 14, township 12 south, range 2 west, which is the most southerly point where it was seen. On the other side of the fault, on the northeast quarter of section 35, township 12, range 2 west, there is about twenty-five feet in thickness of this limestone to be seen, dipping south 20° west, at an angle of about 24°. This is the most southerly exposure of this rock that has been seen in the county.

On the west side of the county, on the north line, this limestone forms the upper escarpment of the bluff, and in crossing the county from Reed's Lading to Bay creek, through the north tier of townships, it forms the bed-rock over all the highlands between the two rivers. Following down the Mississippi, it forms almost continuous exposures along the bluffs on the west side of the county to Hamburg, where the upper escarpment of the bluff is formed in part of this limestone, and in part of the limestones of the Kinderhook group. From this point its outcrop trends eastwardly, and the underlying formations take its place in the river bluffs, but it continues to form the upper portion of the dividing ridge between the two rivers down to the centre of township 12 south, range 2 west, which is its most southerly point of outcrop in the interior of the county, on the north side of the *Cap au Gres* fault. Below that fault it is only seen at one point on the west side of the county, where the upturned edges of its nearly vertical strata constitute the first rock exposure below the *Cap au Gres* bluff. This exposure is about two hundred yards below the southern terminus of the sandstone bluff, and the strata are in a nearly vertical position, dipping south 20° west, at an angle of at least 60°. A measurement across the upturned edges of the strata indicated a thickness of about two hundred feet. The Kinderhook shales and limestones are not exposed here, but probably underlie a part of the valley of the small creek which enters the river at this point. The Keokuk limestone is found immediately succeeding the Burlington here, but with a diminished dip, and it is overlaid by the St. Louis limestone, the upper portion of which holds a nearly horizontal position. The wood cut on page 239 illustrates the position of the various formations seen in connection with this fault much more clearly than any verbal description that could be given.

Keokuk Limestone.—This division of the lower Carboniferous series is only met with at the single locality above mentioned in this county. It immediately succeeds the Burlington limestone below the *Cap au Gres* bluff, and, although the dip is considerably less than that of the underlying limestone, it is nevertheless sufficiently strong to carry all the exposed beds of this group below the surface, in a distance of about one hundred and fifty feet. Its entire thickness here, probably, does not exceed one hundred feet, though an accurate measurement could not well be made here. The upper portion appeared to be shaly, and was filled with the siliceous geodes characteristic of the upper part of this group at more northern localities. The lower portion was composed of gray limestones, similar to the

quarry rock at Hamilton and Nauvoo. On the eastern side of the county, it should be found between the outcrop of Burlington limestone, on section 35, township 12 south, range 2 west, and the St. Louis limestone, which appears a short distance below, but no exposure of it was found in this part of the county.

St. Louis Group.—The Keokuk limestones, at the outcrop below the *Cap au Gres* bluff, are succeeded by beds of brown magnesian limestone, some sixty or seventy feet in thickness, which form the lower division of this group. They dip at a moderate angle in the same direction as the lower beds, and are overlaid by compact gray limestones, which are nearly horizontal in their position, and form a perpendicular bluff from forty to fifty feet high. From this point to Johnson's Landing, these gray limestones, which, in the aggregate are probably a hundred feet or more in thickness, form a continuous line of bluffs from fifty to seventy-five feet in height, and a short distance back from the river are overlaid by the Coal Measures. The gray limestones which form the upper portions of this group are even-bedded, and partly concretionary, or brecciated in their structure. At Johnson's Landing, now better known as Belt's Landing, the upper portion of this limestone forms the bluff, for thirty or forty feet above the river level, consisting of compact gray and brown limestones, separated by partings of clay shale, in which the fossil corals of this group, *Lithostrotion mamillare, L. proliferum,* and an undetermined *Syringopora,* are quite abundant.

Below this landjng, the bluffs of the river trend to the eastward, and some of the lower beds come again to the surface, and continue gradually rising to the old town site of Milan, where the limestone bluffs end on the western side of the Illinois river valley. On the eastern side of the county, below the *Cap au Gres* axis, there are but few exposures of this limestone, although it undoubtedly continues along the bluffs on this side of the valley for three or four miles above their southern extremity. North of this axis, the St. Louis limestone has not been found in this county, but south of that point it forms almost the entire limestone exposure.

Coal Measures.—This formation, like the St. Louis limestone, is restricted in its development to the southern part of the county, and is found underlying a considerable portion of the high lands below the *Cap au Gres* axis. Commencing about two miles below this axis, it underlies the highest portion of the county, in township 13, in ranges 1 and 2 west, though exposures of the strata are rarely met with, and consequently its boundaries cannot be very definitely determined. The only coal mine that has been worked to any extent

in this county is Williams' mine, located on a fraction of section 1, township 14, range 2 west, about one mile above Fruitland, and two miles above Belt's, formerly Johnson's, Landing. These mines were opened nearly twenty years ago, and have been worked at intervals down to the present time. The following section, made at these mines, will show the character and succession of the beds, and is, perhaps, as complete a section of the Coal Measure deposits as could be made at any locality in the county:

	Ft.	In.
Brown shale	6	
Hard, gray, concretionary limestone	4 to 6	
Covered slope, with partial outcrop of shale	50	
Brown, sandy shale	15	
Coal		4
Clay shale and iron ore	2	6
Coal	2	2
Fire clay	2 to 8	
Clay shale, passing downward into bituminous shale	12	
Sandstone and sandy shale	20 to 25	
St. Louis limestone to river level	30	

The main coal seam at this point ranges from twenty-four to thirty inches in thickness, and affords a coal of fair quality, though, as the work had been suspended for some time when we last visited the locality, the opportunity for examining the coal was not as good as could be desired. It seemed to be rather free from pyrites, and the analysis, which will be found on a subsequent page, shows its quality to be fully equal to the average of Western bituminous coals. It is overlaid by about thirty inches of clay shale, the upper part of which is quite ferruginous, and forms an impure iron ore about a foot in thickness. Above this, there is another thin seam of coal, which was four inches thick at the only point where we found it exposed. These coals are overlaid by a thick bed of brown shale, which was only partly exposed, but appeared to be about sixty-five feet in thickness, above which was a bed of hard, gray, concretionary limestone, from four to six feet or more in thickness, and above this we saw a few feet of brown shale, which was the highest bed of the Coal Measure series met with in the county. The concretionary limestone contained a number of species of Coal Measure fossils, among which we collected *Spirifer lineatus*, *Athyris subtilita*, *Terebratula bovidens*, *Productus semireticulatus*, *Fusulina*, *sp?* and joints of crinoidea, and small turbinated corals.

Below the main coal seam there is two or three feet of fire-clay, which passes downward into a black shale, which is said to have been reached at a depth of fourteen feet below the coal, but was not penetrated. This black shale probably represents another coal

seam, which may be developed at some point in the county thick enough to be worked. Between this and the St. Louis limestone, we found a partial outcrop of sandy shale and sandstone about twenty-five feet in thickness, which forms the base of the Coal Measure deposits in this county. The Coal Measures, as developed here, seem to include the horizon of at least three coal seams, the lowest being represented by the black shale; but, so far as could be learned from the few openings made in attempting to mine coal in this county, only one seam has yet been found of sufficient thickness to be worked. On Mr. Wm. Love's place, the northwest quarter of section 10, township 13, range 2 west, the gray concretionary limestone, which is found sixty-five feet above the coal at Williams' mine, outcrops on the south side of the hill, about a quarter of a mile south of his dwelling; and probably the whole thickness of the measures, as developed in this county, are to be found here, though there is no exposure of the beds below this limestone in this vicinity. Coal has been found on the southeast quarter of section 26, on the northeast of 36, and on the northeast of 24, township 13, range 2 west, and the Coal Measures probably underlie fully one-half of the high lands in township 13, ranges 1 and 2, in this county.

Quaternary System.—This system is represented in Calhoun county by the three most common divisions, Alluvium, Loess and Drift. The alluvial deposits are mainly restricted to the bottom lands which skirt the Illinois and Mississippi rivers on three sides of the county, except between *Cap au Gres* and Milan, where the limestone bluffs jut boldly out to the river's edge. On the eastern side of the county, from the mouth of the Illinois river to Monterey, the bottom lands average nearly three miles in width, but above Monterey they grow narrower, and range from a quarter of a mile to a mile and a half in width. A considerable portion of these bottom lands is prairie, and form the only natural prairie lands in the county. In the northwestern portion of the county, there is a belt of bottom land, lying between Bay creek and the Mississippi river, which is about four miles wide at the county line, but grows narrower to the mouth of Bay creek, where it is not more than half a mile in width. The most of these bottom lands are dry enough for cultivation, and are among the most productive and valuable lands in the county.

Drift.—The drift deposits in this county probably nowhere exceed forty or fifty feet in thickness, but they cover nearly all the uplands in the county, except at some points along the summit of the bluffs, from whence they have been removed by denudation. They consist

of brown clays, some of which are quite free from gravel, with some bluish beds containing gravel and boulders of considerable size, but good exposures of these beds, except a few feet of the upper portion, are seldom to be seen, as there are no railroad grades or other artificial cuts through this formation in this county. Where the yellow clays of this deposit cover the surface, they form a heavy clay soil, rather hard to work, but quite productive where there is a natural surface drainage.

Loess.—This formation consists of buff, brown or ash colored, marly clays or sandy marl, usually quite distinctly stratified. It caps the river bluffs in nearly all parts of the county, and is also frequently found filling the lateral valleys by which the bluffs are intersected. Just below Gilead, the bluffs as well as the hills, for a mile or more back from the bluffs, are composed mainly or entirely of *Loess*, which is here from fifty to seventy-five feet in thickness. At this point, it appears to occupy the eastern portion of an ancient valley, excavated by some cause in operation before the formation of the existing rivers, but now in part occupied by them, and also in part by the alluvial deposits to which they have given origin. The hills around the *Salt Spring*, and between that and the bottom lands on the Mississippi, are composed of Loess. Where these marly deposits are subjected to a leaching process, they contain numerous calcareous concretions, some of which assume fantastic forms like the "clay stones" of the Connecticut valley, but more frequently they assume an irregularly spherical form, and are known by the popular name of "*petrified potatoes.*" Bleached specimens of the living species of land and fresh-water shells of the adjacent region are found in this deposit, and it frequently affords the teeth and bones of extinct Mammalia, but we are not aware that any have been found in it, in this vicinity.

Economical Geology.

Building Stone.—No county in the State contains a greater variety, or more abundant supply of excellent building stone than this. First, in value and importance, is the Niagara limestone, which outcrops along the river bluffs on the west side of the county, from Hamburg to Gilead, and thence trending back for a mile or two from the river bluffs, it continues southward nearly to *Cap au Gres*, whence it bends abruptly east across the narrow divide between the Illinois and the Mississippi to Monterey. The whole thickness of the formation is exposed here, and from this point it extends north-

wardly on the east side of the county, appearing occasionally in outcrops at the base of the bluffs, as far north as Farrowton, opposite Columbiana. At all the outcrops seen between Gilead and Monterey, this limestone is an evenly bedded buff or brown dolomite, very similar to the rock at Joliet and Grafton, and fully equal in quality to the building stone obtained from either of the above named localities. The only drawback to the immediate availability of this valuable building material, is its situation, a mile or more distant from the Illinois river on the east, and about a half mile from the Mississippi, on the west; but this difficulty could be readily overcome by the construction of a cheap railroad track from the quarries to the river bank. This formation is from fifty to seventy-five feet in thickness in this county, and the whole mass in townships 11 and 12 south, is an evenly bedded buff or brown magnesian limestone, and equal in quality to any building stone to be found in the State.

In the northern portion of the county the Burlington limestone outcrops along the river bluffs, and on most of the small streams. It affords a very good building stone, though not equal to that afforded by the Niagara limestone. The upper part of the formation is a coarse, semi-crystalline limestone, that is easily cut, stands exposure well in a dry wall, and is a useful rock for all the ordinary purposes for which a good building stone is required. Along the river bluffs and on the small streams it can be quarried very cheaply, and will eventually come into very general use for farm buildings, fences, etc.

Between Hardin and Monterey, several quarries have been opened in the Hamilton limestone, which affords a very good material for foundation walls, but the rock is much harder to work than that from the Niagara or Burlington beds. On the west side of the county this rock is too thin-bedded to be of much value as a building stone, and, locally, becomes quite arenaceous, and passes into a quartzose sandstone.

In the vicinity of *Cap au Gres*, the Trenton group, which is from three hundred and fifty to four hundred feet thick, could be made available for building material, and the magnesian limestone, which constitutes the lowest member of the series, is an evenly bedded rock, and would furnish a building stone nearly, or quite equal to the dolomites of the Niagara group. From the favorable position of its outcrop, near the top of the *Cap au Gres* bluff, extensive quarries could be opened at this point at a very moderate expense, and the

rock could be transferred directly on to lighters or barges, and towed to any point on the river where a good building stone was in demand.

Below the *Cap au Gres* axis the St. Louis limestone is the prevailing rock, and forms a continuous limestone cliff along the river to the old town site of Milan, the termination of the bluffs on the Mississippi, in this county. This limestone makes a very durable building stone, but is much harder than the magnesian limestones of either the Trenton or Niagara groups. It is for the most part a thin-bedded light-gray limestone, but contains some layers thick enough for dimension stone, and the outcrops in this county would furnish an inexhaustible supply of building stone of a fair quality.

Limestone for Lime.—The best material for the manufacture of quicklime in this county, is supplied in great abundance by the St. Louis limestone, which may be made available for this purpose at almost any point where it outcrops along the river, for a distance of more than twenty miles. Some beds in this formation, however, are arenaceous, and contain too great a proportion of siliceous or argillaceous material to be readily converted into lime, while others are a nearly pure carbonate of lime in their composition, and make a very pure white lime. The outcrop of this formation for so great a distance along the river, in the most favorable position for carrying on this branch of manufactures, renders this one of the most eligible points on the river for prosecuting this business on a large scale. The kilns could be constructed so near the river, that the manufactured article could be readily transferred on board steamboats, or barges, thereby saving all expense of land transportation; and the overlying coal beds, which outcrop in close proximity to the limestone, would furnish a cheap and abundant supply of fuel; so that the most favorable conditions exist here, apparently, for the prosecution of this business on an extensive scale. In the northern and central portions of the county, the Burlington limestone is the only rock that can be made available for this purpose, except between Gilead and *Cap au Gres*, where the Trenton limestones are found, a portion of which seem to afford a good material for this purpose. None of the limestones of these groups, however, afford as pure a lime as some of the beds of the St. Louis series, nor do they outcrop generally under such favorable conditions for the manufacture of lime.

Glass Sand.—The St. Peters sandstone, of which nearly one hundred and fifty feet in thickness is exposed at the *Cap au Gres* bluff, in this county, will furnish an excellent white sand for the manu-

facture of glass, in great abundance. No other rock in the Mississippi Valley furnishes a sand for this purpose equal to that obtained from this formation, and at the point above mentioned the supply of this material is absolutely inexhaustible, and the outcrop is so situated that the material could be transferred directly from the quarry onto steamboats or barges, and cheaply transferred to any point on the river where it might be desirable to establish glass manufactories. At LaSalle this business is already established, and the material is obtained from an outcrop of this sandstone in that county, and there is no apparent reason why the manufacture of glass should not be successfully carried on here as well as there.

Minerals.—Small pieces of the sulphuret of lead, or "galena," have been found in the superficial deposits of this county, as well as in various other portions of the State, and their discovery has led to considerable speculation as to the probability of finding lead mines in this region; but, although the entire thickness of the Trenton group, the true lead-bearing formation of the Northwest, is well exposed here, we find no indications of its being a mineral-bearing deposit in this portion of the State. On the contrary, it is entirely different in its lithological characters from the lead-bearing rocks of the Northwest, being here a rather soft, coarse-grained, yellowish-gray limestone, exhibiting nowhere in this region the magnesian character that everywhere prevails in the lead-producing rocks of lower Silurian age. It is probable the few specimens of galena found in this county have been transported from the northern lead mines by drift agencies, as both galena and native copper are frequently found in the drift deposits in various portions of the State, and under conditions that show that they have no relation with the underlying formations. Even if the specimens of lead ore that are reported to have been found in the vicinity of the outcrop of the Trenton limestone in this county, really came from that formation, they have not indicated the presence of such an amount of lead in the rock formations of this county as would justify the expectation of their affording productive lead mines. The same agency by which boulders of granite, sienite and other metamorphic and igneous rocks have been transported from localities hundreds of miles to the northward, would also account for the occurrence, in the drift material in which they are embedded, of any other mineral or rock that is known to occur in the direction from which the great mass of the drift material has come.

Iron, both in the form of a carbonate and of a sulphuret, occurs in the Coal Measures in this county. The carbonate is ....

monly met with in the form of nodules, or "kidney ore," in the shales associated with the coal, while the sulphuret occurs in the coal itself, as well as in the shales, in yellow or silvery-gray crystals, and often forming nodular concretions of considerable size. The sulphuret is worthless as an ore of iron, and is only useful when it occurs in large quantities for the manufacture of copperas and alum, both of which may be obtained from it. The carbonate is a valuable ore for the production of metallic iron, whenever it can be found in sufficient quantity to justify the establishment of a furnace.

The shales forming the roof of Williams' coal are highly ferruginous, and there is about a foot in thickness of impure iron ore between the main coal seam and the thin four-inch seam above it, at the only locality where we found an exposure of the shales forming the roof of this coal. Nodules of the carbonate of iron were also seen at other points which had, no doubt, come from the shales of the Coal Measures, but we met with no body of iron ore in this county where it seemed to be in sufficient quantity to become valuable for the production of iron.

Coal.—Although there is a development of about one hundred and twenty feet in thickness of strata belonging to the Coal Measures, in this county, including the horizon of at least three seams of coal, only one has yet been found thick enough to pay for working. This seam has been partially opened at several points in the county, but no systematic mining seems to have been attempted except at Williams' mine, situated in the bluffs of the Mississippi river, about a mile above Fruitland Landing. The coal is here about twenty-six inches thick, of good quality, and apparently quite free from the sulphuret of iron.

An analysis of this coal, by Mr. HENRY PRATTEN, reported in Norwood's "Analyses of Illinois Coals," gave the following results:

Specific gravity	1.2631
Loss in coking	45.7
Total weight of coke	54.3
	100.0

ANALYSIS.

Moisture	4.8
Volatile matters	40.9
Carbon in coke	49.1
Ashes (brown)	5.2
	100.0
Carbon in coal	53.06

Without a more complete exposure of the strata, and in the absence of fossils, both animal and vegetable, in connection with this coal seam, it is difficult to say exactly where this seam belongs in the general section of the Coal Measures, but from the appearance of the coal, as well as from the stratigraphical position which it occupies, I am inclined to regard it as No. 2, or the equivalent of the Murphysboro and Colchester coals. It is not very uncommon to find this seam divided as it is here, and sometimes it is so equally divided that neither division is thick enough to be worked separately. If this conclusion is confirmed, then No. 1 would be represented by the black shale said to have been penetrated at the depth of about fifteen feet below the main seam, and No. 3 would belong about the horizon of the concretionary gray limestone that lies about sixty-five feet above it. But little has yet been done towards developing the coal in this county, although the mines were opened in the river bluffs at an early day, and have been worked at intervals for years. This seam has only been opened at two or three points, away from the river, where the coal was found outcropping in the ravines by which the Coal Measures are intersected. Coal seams no thicker than this are worked with profit in many portions of the State, where the market facilities are no better than they are here, where the outcrop is on the bank of the Mississippi, and the coal would all find a ready market without incurring the expense and risk of transportation.

Brine Springs.—On the northwest quarter of section 16, township 11 south, range 2 west, there is a large sulphur spring, slightly impregnated with salt. The water is said to have been a much stronger brine formerly than now, but a boring was made to the depth of 198 feet, which changed the character of the water flowing from the spring, so that it is now a strong sulphur water, but so strongly impregnated with salt as to render it rather unpalatable. This spring flows out from the horizon of the Cincinnati group, but the water probably comes from the Trenton limestone, or else comes up through a crevice in that rock from some older formation, as that limestone was struck in the well at a depth of twenty-two feet. Fine springs of fresh water abound in the central and northern portions of the county, where the Burlington limestone is the prevailing rock.

Soil and Agriculture.—The surface over a large portion of the uplands in this county is quite broken and hilly, and in some portions the hills are too steep for cultivation, but the soil is excellent, being generally predicated upon the loess, and as a fruit growing

region it is hardly surpassed by any portion of the State. The soil is generally a chocolate colored clay loam, such as we generally find over the regions adjacent to the river bluffs, where it rests upon the loess. It has a complete surface drainage from the rolling character of the country, and is very productive in all the cereals and fruits of a temperate climate. This county has but recently attracted the attention of horticulturists, and a number of extensive fruit farms have been opened within the past five years. Extensive peach and apple orchards are already in bearing, and show by their healthy appearance and abundant crops of fruit the complete adaptation of the soil on these uplands to the cultivation of fruit. A good many vineyards have been planted in this county, and have generally produced abundantly, yielding most satisfactory returns for the capital and labor expended.

The bottom lands in this county are exceedingly productive, and yield annually large crops of corn, wheat, oats, barley and grass, and may be fairly ranked among the most valuable and fertile lands in the State. Calhoun county has been entirely under-estimated as to its value as an agricultural region, and when its uplands are planted with orchards and vineyards, and its rich alluvial bottoms are covered with the cereals to which they are adapted, it will compare favorably, in the amount and variety of its annual productions, with the most favored portions of the State.

In closing my report on this county, I desire to express my acknowledgments to Capt. Wm. H. Reed, of Reed's Landing, and his excellent lady, for the cordial hospitality of their pleasant home, which they so kindly extended to me while engaged in prosecuting my examinations in the northern part of this county, and also, in behalf of the State, to acknowledge the receipt of valuable specimens of minerals, fossils and Indian antiquities, contributed by them to the State cabinet. To their little daughter, Miss Eliza Reed, the State collection is also indebted for a beautiful fossil crinoid, found by her in the Burlington limestone, in the vicinity of their residence.

CHAPTER XII.

PIKE COUNTY.

Pike county lies between the two great rivers, the Illinois and the Mississippi, and is bounded on the north by Adams and Brown counties, on the east by the Illinois river, on the south by Calhoun county, and on the west by the Mississippi. It embraces a superficial area of about twenty-one townships, or seven hundred and fifty-six square miles, and the surface is generally rolling, and on the borders of the streams it is quite broken and hilly. A large proportion of the surface, on the upland, was originally heavily timbered, but there are several small prairies in the central and northern portions of the county. It is a well watered county, being intersected by numerous small streams, besides the two large rivers which form its eastern and western boundaries. Among the principal streams in the interior of the county are McGee's creek and its tributaries, in the northeastern part; Bay creek, which traverses its central and southern portions; and McDonald's creek, Hadley's creek, and some others of less importance, which intersect the western part, and empty into a bayou, which traverses the bottom lands on the western side of the county, through its whole extent. The valley of the Mississippi is from eight to twelve miles in width, and, as the present river channel is along the western edge of this valley, it leaves a wide belt of bottom lands on the western border of the county, containing an area of about one hundred and sixty square miles, or more than one-fifth of the whole area of the county.

The general level of the uplands may be estimated at from two to three hundred feet above the great water courses, on either side, with no very well defined water-shed to determine the courses of the smaller streams. The soil on the timbered lands is generally a chocolate-colored clay loam, becoming lighter colored on the breaks of the streams and in the vicinity of the river bluffs.

The geological structure of this county is somewhat peculiar, and the strata exposed within its limits comprise the upper part of the Niagara limestone, the whole series of lower Carboniferous limestones, except the Chester group, and a limited thickness of Coal Measures, with the usual surface deposits of loess and drift. No well defined beds of Devonian age were seen in the county, though a little below the southern line, in Calhoun county, we found two or three feet of quartzose sandstone resting upon the Niagara limestone, which, no doubt, belongs to the Hamilton group, and is the most northerly outcrop of this formation known in this part of the State. The green and blue shales, sometimes including a few feet of chocolate-brown, or black shale, which immediately overlies the Niagara limestone here, contains no fossils, and shades into the arenaceous beds of the Kinderhook group so completely that no line of separation can be seen between them. Hence, we have included these shales, which have heretofore been referred to the age of the "Black Slate," of Ohio, in the lower Carboniferous series, and consider them as probably the equivalent of a black shale that is found in Ohio intercalated in the Waverly sandstone. This, in the absence of the Hamilton limestone, or any lower division of the Devonian system, leaves the lower Carboniferous beds resting immediately upon the upper Silurian limestones.

A very decided want of conformability may be observed between the Coal Measures and the limestones on which they rest in this county. Usually in this portion of the State, if the sequence of the strata is complete, the Coal Measures rest upon the upper beds of the St. Louis limestone, but this group is wanting here, except on the northern limits of the county, and the Coal Measures are found resting unconformably on the Keokuk limestones, in the east part of the county, and on the Burlington beds, in the western portion. This peculiar feature in the geology of the county has resulted from the elevation and subsequent denudation of the strata, anterior to the deposit of the coal.

In addition to the disturbance of the strata, resulting from the *Cap au Gres* axis, described in the report on Calhoun county, which, no doubt, also affected the strata in the southern part of Pike, there is another, though less decided, axis in this county, which, probably, changed the level of the lower Carboniferous limestones over nearly the whole extent of the county, and resulted in the subsequent denudation of the strata already alluded to. This axis occurs in the vicinity of Six-mile creek, and its effects are most apparent on the northwest quarter of section 7, township 7 south, range 4 west, where

the Niagara limestone rises abruptly from beneath the surface of the bottom lands at the foot of the bluffs, and, dipping north 20° west, at an angle of 7°, rises, in a distance of scarcely more than a hundred yards, so as to form a perpendicular cliff from forty to fifty feet in height. There has, evidently, been a dislocation of the strata here, for we find this limestone outcropping along the foot of the bluff, from Rockport down nearly to the point where it rises so suddenly from the river bottoms, and showing above this point no very decided inclination. The elevating force, however, was not sufficient to bring the whole thickness of the group above the surface, although about fifty feet in thickness is exposed. The following section will show the thickness of the formations found in this county, but for reasons already given, they do not always hold the same relative position as in the section given below:

	Feet.
Quaternary deposits (loess and drift)	40 to 100
Coal Measures	20 to 60
Lower Carboniferous—	
St. Louis limestone	00 to 30
Keokuk group	100 to 125
Burlington limestone	150 to 200
Kinderhook group	100 to 120
Niagara limestone	00 to 50

The Niagara limestone is only found in the southwest part of the county, where its main outcrop is at the base of the bluffs, between Rockport and the south line of the county, and on Six-mile creek, for a short distance up that stream. Where this rock first appears, the upper portion is a rather thin-bedded rough gray limestone, becoming more massive below, and on Six-mile creek, it is partly a regular-bedded buff or brown dolomite, and presents the usual characters of this formation at other localities. It contains a few fossils at the outcrop in the vicinity of Pleasant Hill, among which we obtained fragments of *Trilobites*, a few fossil shells, too imperfect for determination, and a single specimen of *Halysites catenulatus*.

At Mr. Wells' place, on the northwest quarter of section 17, township 7 south, range 4 west, the buff colored magnesian beds of this group are exposed about ten feet in thickness, and the rock has been quarried for general use as a building stone in the neighborhood. The beds appear to dip here in an opposite direction from those at the point where the rock rises so suddenly from beneath the surface of the bottom lands, at the foot of the bluffs, the direction being to the south 20° east, and the angle about 6°. On the southeast quarter of section 8, in the same township, there is an exposure of about twenty-two feet of this limestone, the lower ten feet being a gray evenly-bedded limestone, and the upper twelve

feet a buff colored magnesian rock, closely resembling the rock from the Grafton quarries. It is the prevailing rock at Pleasant Hill, and forms a limestone bench about thirty feet in height, above the road, at the base of the bluffs. Two miles north of Pleasant Hill, on a branch of Six-mile creek, the upper part of this limestone is exposed in the bed of the creek, dipping north 30° west, about 2°. Only about six feet in thickness is exposed here, and the rock is a regularly-bedded brown magnesian limestone. This seemed to be about the most easterly outcrop of this formation, and it is here overlaid by the shales of the Kinderhook group. From this point southwestward, to the Calhoun county line, occasional outcrops of this limestone may be seen along the base of the bluffs, and its entire outcrop in this county is restricted to the vicinity of the river bluffs between Rockport and the south line of the county.

Kinderhook Group.—One of the best exposures of this group in this county, is at the point of the bluff just above the village of Kinderhook, from whence it has received its name. The following is the section at this point:

	Feet.
Loess capping the bluff	20
Burlington limestone	15
Thin-bedded fine grained limestone	6
Thin-bedded sandstone, and sandy shales	36
Argillaceous and sandy shales, partly hidden	40

The three lower beds of the above section belong to this group, and there are some twenty feet or more of still lower beds, which do not appear above the surface here. The thin-bedded, fine-grained limestone which lies at the top of the series here, resembles the fragmentary limestone at Burlington, Iowa, which, at that locality, contains *Chonetes Fischeri*, *Rhynchonella pustulosa*, and *Spirifer biforatus*, but no fossils were found in it here. The thin-bedded sandstones below this, however, abound in fossil shells, belonging to the genera *Aviculopecten*, *Spirifer*, *Orthis*, and *Productus*, mostly identical with those from the grit stones at Burlington, which belong to the same horizon. The argillaceous shales at the base of this group have afforded no fossils as yet from any of the localities examined in this county. From Kinderhook southward, along the bluffs on the west side of the county, this group is more or less exposed below the Burlington limestone, which forms the upper escarpment, and at Rockport nearly the whole of the group may be seen, forming the following section:

	Feet.
Loess capping the bluff	20 to 30
Arenaceous limestone and shale	16
Unexposed strata	20
Green and blue clay shales	30
Covered slope to the level of the road	32

On our first visit to this county, in 1853, we found at this point a brecciated oolitic rock, about three feet thick, which receives a high polish and makes a beautiful marble. At a more recent visit we did not find it exposed, and it is probably included in the twenty feet of unexposed strata, below the arenaceous beds near the top of this section. This arenaceous limestone contains a few fossils, among which are *Spirifer Marionensis, S. hirtus, Productus pyxidatus, P. arcuatus, Rhynchonella Missouriensis,* and *Chonetes geniculata.* About two miles below Atlas, the Burlington limestone caps the bluff, and we find the Kinderhook group outcropping below it, affording the following section:

	Feet.
Burlington limestone	12
Magnesian limestone	8
Unexposed	18
Sandy shales	38
Blue clay shales	44
Covered slope to the level of the road	27

Probably about fifteen feet in thickness at the base of this section is occupied by the Niagara limestone, leaving 120 feet as the aggregate thickness of the Kinderhook group at this point. The sections above given will illustrate the general character of this group, as it appears in this county, where it is composed mainly of sandy and argillaceous shales, with some thin beds of limestone. Its outcrop is confined to the river bluffs, and the lower courses of the small streams that intersect them. Commencing on the west side of the county, at the north line, we find from forty to fifty feet of these shales outcropping below the Burlington limestone, which forms the upper escarpment of the bluffs, and thence southward, they gradually rise until, at Rockport, we find the whole thickness of the group in partial exposures above the level of the bottom road. In the vicinity of Pleasant Hill, the bluffs are composed of Niagara limestone, overlaid by loess and drift, and the outcrop of the Kinderhook is found further back on Six-mile creek and on the branches of Bay creek. On Cold run, about a mile above the point where it enters Bay creek, the green and blue shales of the Kinderhook group are well exposed, giving a measured section 31 feet in thickness. These are overlaid by sandy shales, that are but partially exposed, but containing a few feet in thickness of fine-grained evenly-bedded sandstone, that has come into

general use in the neighborhood for constructing chimneys, building foundation walls, etc. It is said to be a very refractory stone, that is scarcely affected by the action of fire, and also possesses a fine, sharp grit, which makes it a useful material for grindstones, whetstones, etc., for which it has been very generally used in this vicinity. This bed, however, is only from three to four feet in thickness at the point where we found it exposed, which was about three-quarters of a mile east of Mr. J. G. Sitton's farm*. These beds, and the blue and green shales which underlie them, will be found outcropping on all the tributaries of Bay creek, in this vicinity, as well as on the main creek.

Crossing the county to the Illinois river bluffs, near the south line, we find these beds forming the lower portion of the bluff, and well exposed, on the lower course of Bee creek, and in the bed of the creek at the mill there is a partial outcrop of the black shale, which sometimes forms the lowest strata of the group. The beds are not fully exposed here, but in ascending the stream, the argillaceous and sandy shales are occasionally seen in partial exposures, showing that the group retains essentially the same characters on this side of the county as on the other. From this point northward, these shales appear in occasional outcrops along the bluffs, to the vicinity of Bedford, where they dip below the surface and are seen no more. As this group does not form the bed rock over any considerable surface area in this county, it fails to impart any of the peculiar topographical features to the surface here, which usually characterize it where it is well developed, with no overlying limestone to modify its influence on the topography of the country. Then, it almost invariably forms a broken and hilly region, so marked in its character that the extent of its outcrop may be accurately defined, from the peculiar topographical features of the surface alone. But almost everywhere in this county, where the group is exposed, the Burlington limestone overlies it, and therefore determines the topographical features of the region also underlaid by the shales and gritstones of this group.

Burlington Limestone.—This limestone forms the bedrock over fully one-half of the entire surface of the uplands in this county, and its outcrop, in a general way, may be thus described: Commencing on the western side of the north line of the county, it forms a belt

* A rock exactly like this, from Marshalltown, Iowa, and from the same geological horizon, receives a high polish, and is used for tables and various other purposes, as an ornamental stone, and the rock from the above named locality, in Pike county, seems to be equally as well adapted for this purpose.

from five to ten miles in width, the western border of which is defined by the river bluffs, and extending thence to the southern line of the county, forming the bed rock over all that part of the county lying south of Pittsfield, and from that point northward to Griggsville Landing, and south to the Calhoun county line, underlying all the highlands in that portion of the county south of Pittsfield, except a very limited area in the vicinity of Pleasant Hill, where the Niagara limestone forms the surface rock. Its thickness ranges from one hundred and fifty to two hundred feet, but usually not more than fifty or one hundred feet can be seen at a single outcrop. The best exposures of this rock are to be seen in the bluffs of the Illinois and Mississippi, and on some of the principal creeks in the western and southern portions of the county. The rock is a rather coarse-grained gray limestone, with intercalations of buff or brown layers, and is largely composed of the fossilized remains of the *Crinoidea* and *Mollusca*, that swarmed in countless myriads in the old Carboniferous ocean, during the formation of this limestone. It is the *Crinoidal* and *Encrinital* limestone of some of the old observers, and it was so designated in consequence of its being almost entirely composed, at some localities, of the remains of these radiated forms of animal life. Indeed, the main portion of the rock consists of the calcareous plates and joints of *crinoids*, with barely enough mineral matter to cement the organic remains together.

In the Mississippi bluff, near the north line of the county, there is from forty to fifty feet of the lower portion of this limestone exposed, forming the upper escarpment of the bluff. These lower beds consist of alternations of gray and brown limestone, usually in regular and tolerably thick beds, and contain *Orthis Michelini*, *Euomphalus latus*, *Spirifer Grimesi*, and *S. imbex*. The pygidium of a beautiful Tribolite was found in these lower beds, near Kinderhook, to which the name, *Philipsia tuberculata* has been given. From the north line of the county, southward, to a point about ten miles below Atlas, this limestone forms the upper portion of the bluff at most of the points examined, and from thence it trends eastwardly across Six-mile creek to the waters of Bay creek, and caps the bluffs on the eastern side of that creek, at the south line of the county. It outcrops on all the small streams south of Pittsfield, and is extensively quarried on Big Blue creek, about four miles southeast of there, for building stone for the supply of the town and adjacent country.

On the eastern side of the county, the most northerly outcrop of this limestone is in the vicinity of Griggsville Landing, where the cherty beds of the upper division of this rock are exposed at the base of the bluff. The outcrop is here about fifty feet in thickness, and so far as it is exposed in the quarries opened, the rock consists of alternations of thin-bedded gray limestones, with seams of chert. The cherty material is also disseminated through the limestone strata, in nodules and concretionary masses of considerable size. From this point to Montezuma this limestone forms a low bluff, seldom rising more than fifty feet above the level of the adjacent bottom lands. At Montezuma, where several quarries have been opened in this rock, the beds exposed are about fifty feet in thickness, the lower ten feet being a massive gray limestone, comparatively free from chert, while the remaining portion consists of thin-bedded brownish-gray crinoidal limestone, with considerable cherty material in seams and nodules. Fossils are quite abundant, and among others not yet determined, the following species were collected here: *Spirifer striatus, S. Grimesi, S. imbex, Productus punctatus, P. semireticulatus, Strophomena analoga, Orthis Michelini, Euomphalus latus, Lyropora retrorsa, Evactinopora grandis, E. sexradiata, Agaricocrinus planoconvexa, Platycrinus planus,* and several species of *Actinocrinus.* From Montezuma to Bedford this limestone rises rapidly, and the bluffs immediately north of Bedford are at least one hundred and fifty feet in height, and consist mainly of this limestone, capped with a few feet of Loess. Just below Bedford the underlying shales appear at the base of the bluffs, and from thence to the south line of the county, the bluffs range from one hundred and fifty to two hundred feet, or more, in height, the upper escarpment consisting of a hundred feet, or more, in thickness, of Burlington limestone, while the talus below covers the shaly beds of the Kinderhook group.

On Bay creek this limestone is well exposed, and forms the main portion of the bluffs along this stream, from the vicinity of Pittsfield to the point where it intersects the river bluffs, about two miles above the Calhoun county line. It is the most important of all the limestones exposed in this county, whether considered in reference to the extent of surface over which it outcrops, or the amount and value of the economical material which it affords. Although as a building stone it is not quite equal to the magnesian beds of the Niagara group, which outcrops in the vicinity of Pleasant Hill, it is, nevertheless, a very durable stone, and may be made availa-

ble for all the ordinary uses for which such a material is required, and it is easily accessible over about one-half of the whole area of the county.

Keokuk Group.—This group, which immediately succeeds the Burlington limestone in the ascending order, outcrops over a considerable area in the northern and northeastern parts of the county, where it is frequently found immediately beneath the Coal Measures, the St. Louis group, which should properly intervene, having been removed by denudation anterior to the Coal epoch. It consists of light-gray and bluish-gray cherty limestone at the base, which closely resembles the upper beds of the Burlington limestone in their lithological characters, so that it would sometimes be difficult to define the line of separation between them, except for the fossils, which always serve to distinguish them. Some of the limestone strata are quite as *crinoidal* in their structure as the Burlington limestone, but they are usually more of a bluish-gray in color, and may therefore be readily distinguished, even in hand specimens, from the underlying formation. There is usually a series of cherty beds, from ten to thirty feet in thickness, separating the main limestones of these two groups, which may properly be considered beds of passage from one limestone to another. The upper division of this group consists of calcareo-argillaceous shales and thin-bedded limestones, containing geodes lined with crystallized quartz, chalcedony, calcite, dolomite and sometimes, but more rarely, with crystals of zinc blende and iron pyrites, the latter usually in minute crystals implanted on quartz. This division may be seen a mile and a half southeast of Griggsville, and, where it first appears beneath the Coal Measures which rest upon it here, the geodes are found embedded in a ferruginous sandstone that perhaps represents the Conglomerate, which usually lies at the base of the Coal Measures. A similar occurrence was observed at Moore's coal bank, in Scott county, as has been mentioned in the report on that county. This indicates some erosive action, anterior to or during the formation of this Conglomerate, by which the shales in which the geodes were originally embedded were swept away, and the geodes were covered and enclosed in sand, which subsequently hardened into a conglomerate.

The shales and shaly limestones of the geodiferous division of this group are exposed in the vicinity of Perry Springs, and outcrop on the tributaries of McGee's creek, in that vicinity. The springs flow out of these shaly limestones, and probably derive the small amount of mineral matters which the waters contain from these

beds. On McGee's creek, at Chambersburg, the limestones of this group form the bed of the creek, and the overlying shales form the main portion of the bluffs on the creek throughout its course in this county.

The limestones which constitute the lower division of this group occupy the lower portion of the river bluff, about half a mile above Griggsville Landing, and from thence to Chambersburg. Their entire thickness probably does not exceed sixty feet, and at some points the beds are quite massive and comparatively free from chert, and form an excellent building stone. This is the character of the rock at some points on the south fork of McGee's creek, between Perry and Griggsville.

In the northwest part of the county this limestone is exposed on Hadley's creek; and in the vicinity of Huntley's coal bank, where the coal abuts directly upon it, we find some of the characteristic fossils of this formation, among which were *Spirifer Keokuk*, *S. neglectus*, and some teeth of fossil fishes. Fossils are not found very abundant at any of the localities where we found this limestone exposed, and as but few quarries have been opened in it, there is but a limited field for the collector among the outcrops of this limestone in this county. At Perry Springs we obtained two specimens of *Agaricocrinus Americanus* and one of *Archimedes Owenana*. The same species also occur in the thin-bedded limestones in the bed of the creek at Chambersburg.

St. Louis Group.—We saw no indications of the presence of this group anywhere in the county, except on the breaks of McGee's creek, in the northeast part of the county, and on the south fork of the same creek in the vicinity of Perry. The beds exposed here consist of brown magnesian limestone and shales, and range from twenty to thirty feet in thickness. One mile and a half northwest of Perry, quarries have been opened in the brown magnesian limestone of this group, which is there about eighteen to twenty feet thick, and directly overlies the geodiferous shales of the Keokuk group. About three miles north of Perry Springs, and near the north line of the county, these magnesian beds are also exposed, and are overlaid by some shaly beds, the whole attaining a thickness of about twenty feet. No exposure of the gray concretionary limestone, which usually forms the upper member of the group, was met with in this county.

Coal Measures.—The coal formation occupies but a limited area in the central and northern portions of this county, underlying the whole of township 4 south, range 4 west, and a portion only of the

four surrounding townships. The entire thickness of the formation, as it appears in this county, probably does not exceed sixty feet. The following are the principal points where coal has been dug in this county:

Huntley's old bank, on the northwest quarter of section 15, township 4 south, range 5 west. Coal sixteen to twenty-four inches thick, overlaid by about six inches of black shale.

Huntley's new bank, on the northwest quarter of section 10, township 4 south, range 5 west. The coal is here about six feet thick, with a parting of clay shale in the middle about two inches in thickness. The coal in the upper part of this seam is rather soft, and contains considerable bi-sulphuret of iron. The lower division affords a harder and better coal, and rests upon a gray fire-clay two feet or more in thickness. Two or three hundred yards northeast of this opening a coal seam outcrops at about the same level with this, which is only about eighteen inches in thickness, and is overlaid by a blue clay shale containing large septaria. This clay shale is apparently quite similar to that which forms the roof at Huntley's mine, and it is probable that the greatly increased thickness of coal at the point where it is now worked is due to some local cause, and perhaps to the meeting of the two seams, which are only separated by the parting of clay shale, coming together in a pocket or depression in the limestone. The coal here abuts directly upon the Keokuk limestone, which outcrops within a few feet of the coal, and in the bed and bluffs of the creek below it. It is not probable that this thickness of coal strata will be found extending over any considerable area of surface, as the cause which has produced it is most probably entirely local, for no other outcrop of coal is known, either in this or the adjoining counties, where the seams range above two feet, or thirty inches at most, in thickness. Three miles east of Barry coal has been dug on a small branch south of the Philadelphia road, and a mile further south, on the north fork of the creek which intersects the river bluffs near New Canton, there is a blue clay shale, from twenty-five to thirty feet thick, exposed along the creek, which contains *septaria* and *teuten-mergel*, and closely resembles the shale over the coal at Huntley's mine. From this point the western boundary of the Coal Measures trends southeastwardly to Houseworth's coal bank, two miles and a half northwest of Pittsfield. This mine is on the northeast quarter of section 16, township 5 south, range 4 west; coal about eighteen inches thick, overlaid by about three feet of dark

blue shale passing upward into sandy shale, of which about ten feet in thickness was seen above the coal. The coal seam is variable in its thickness here, and ranges from sixteen to twenty-two inches; but at Mr. Harshman's place, a mile north, it is about two feet thick. An analysis of Houseworth's coal, by Mr. HENRY PRATTEN, as reported in Norwood's "Analyses of Illinois Coals," gave the following result:

Specific gravity	1.2203
Loss in coking	49.5
Total weight of coke	50.5
	100.0

ANALYSIS.

Moisture	5.0
Volatile matters	44.5
Carbon in coke	45.5
Ashes (white)	5.0
	100.0
Carbon in coal	53.2

Four miles west of Griggsville, on the northeast quarter of section 13, township 4 south, range 4 west, coal has been found on Mr. Dunham's place. The coal is from fourteen to twenty inches thick, and is overlaid by about two feet of fossiliferous black shale. Also, on the southeast quarter of section 11, in the same township, the same seam is exposed, and averages about eighteen inches in thickness, and is overlaid by black shale, enclosing nodules of bi-sulphuret of iron with fossil shells. This coal outcrops at several localities, in the ravines along the road between Griggsville and Salem, and also between Salem and New Philadelphia.

A half mile south of Griggsville, coal has been worked on Mr. Parker's land. The seam varies in thickness, from eighteen to twenty-four inches, and is overlaid by blue shale. Three-quarters of a mile east of this point, the shales and geodes of the upper part of the Keokuk group outcrop along the same creek on which the coal is found, and half a mile south of Houseworth's coal the Keokuk limestone was seen, and this seems to be the formation on which the Coal Measures rest, in the central and northern portions of the county, except at the outcrops east and southeast of Barry, where they appear to overlie the Burlington limestone.

On Mr. Lazarus Ross' place, a mile and a half northwest of Perry Springs, some indications of coal may be seen in the bluffs of the middle fork of McGee's creek. Partial outcroppings of black and dark blue shales appear here, but so intermingled with drift clays, by the slipping of the beds, that it is difficult to say whether

the shales were *in situ*, or had been moved by drift agencies. Some attempts have been made here to find coal, but without success.

In the southeast part of the county we found an outcrop of the Conglomerate, which usually forms the base of the Coal Measures, overlying the Burlington limestone on Mr. Ch's Meisenbach's place, on the northwest quarter of section 30, township 7 south, range 2 west. About ten feet in thickness of the sandstone was exposed, where there had been an old quarry, and the whole thickness of the bed at this point is probably not less than fifteen or twenty feet. This sandstone also outcrops on the adjoining farm, owned by Mr. Jordan. This is probably an outlier of sandstone that was originally deposited in a depression of the limestone, where it has been protected from erosion, while the surrounding strata have been removed by denuding forces.

From the outcrops of coal already mentioned in this county, it will be seen that the coal is generally too thin to be profitably mined, except where it can be done in open trenches by throwing off the overlying material. Coal cannot be profitably mined in a regular way, either by tunnel or shaft, where the seam averages less than two feet in thickness, and as the seams in this county are usually less than that, they are of little value unless so situated as to be easily worked by "stripping." The seam at Mr. Huntley's, near the north line of the county, is, however, an exception, and may be worked to good advantage by any of the ordinary modes of mining. It is probable, however, from the general development of the coal both in Pike and Adams counties, that the unusual thickness of the seam or seams at this point is a merely local phenomenon, and will be found to extend over only a small surface area. Local thickenings of this kind are not uncommon, and are denominated "pockets" by the miners, the coal sometimes thickening to twelve or fourteen feet, and yet covering only an acre or two of surface, thinning out entirely in a few rods in either direction.

Quaternary System.—A broad belt of alluvial bottom lands, from six to twelve miles in width, skirts the western border of this county, through its whole extent from north to south. The soil on these lands is exceeding fertile, and where they are elevated above the annual overflow of the river, they comprise some of the most valuable and productive lands in the county. Belts of heavily timbered lands skirt the small streams that intersect these alluvial bottoms, and also the eastern bank of the Mississippi river, through the whole extent of the county from north to south, but a large portion of these lands were originally prairie, and have been more

recently transformed into highly cultivated farms. But little is known of the character of these alluvial beds below the depth of ten or twelve feet, this much only being exposed in the channels of the streams by which they are intersected; but if we could penetrate down to the solid rock bottom, we should most probably find formations which do not appear anywhere in this region above the surface. That the broad valley of the Mississippi and other western streams was formed long anterior to the existence of the rivers which now occupy them, admits of no question, for at many points we find this valley partially filled with beds of drift clay and gravel exactly like that which covers the adjacent highlands, showing that the formation of the valley antedates the Drift period; but whether these valleys existed during the Tertiary age, or the age preceding the Drift, is a point not yet fully settled, though some facts have been observed which lead to that conclusion. If we could see a complete exposure of the beds underlying these alluvial bottoms, down to the solid rock on which they rest, it is quite probable that evidence might be obtained that would help to determine this interesting question.

So far as these alluvial deposits can be determined by the natural exposures in the banks of the streams, they consist of alternations of clay, sand and loam, in quite regular strata, but of variable thickness. On the east side of the county, there is very little bottom land from the south line of the county to the northern part of township 4 south, range 2 west, where it begins o widen, and from that point to the north line of the county, the bottoms along the Illinois river range from two to five miles in width. These bottom lands, however, are not so much elevated as those on the west side of the county, and are generally too low and wet for cultivation. A portion of them are heavily timbered with cottonwood, sycamore, soft maple, elm, ash, hackberry, honey locust, linden, black walnut, water oak, hickory, etc.

Loess.—The river bluffs on both sides of the county are capped with this formation, which ranges in thickness from ten to sixty feet or more. It always overlies the Drift where both are present, and hence is of more recent origin, and it also differs in its character and appearance from the drift deposits. It generally consists of buff or brown marly clays and sands, usually stratified, and often so coherent as to remain in vertical walls twenty or thirty feet in height, where an artificial cut is made through it. On analysis, it generally affords from seventy-five to eighty per cent of silica, from ten to fifteen per cent of allumina and peroxide of iron, from three

to four per cent. of lime, and one to two per cent. of magnesia. Its greatest thickness is usually on the top of the river bluffs, and in the lateral valleys immediately adjacent to them, and from thence it thins out generally towards the summit level of the interior. In the vicinity of Chambersburg, in the northeast part of this county, the Loess forms the main portion of the bluffs, so far as can be seen, and appears to be at least sixty or seventy feet in thickness. The timbered lands adjacent to the bluffs on both sides of the county are usually underlaid by this formation, and it furnishes a light porous sub-soil, which is admirably adapted to the growth of fruit trees, vines, and small fruits. In many localities it contains a variety of fossil shells, which present the usual bleached and water-worn appearance of the dead shells of our ponds and bayous. It also affords a variety of calcareous concretions, which assume many imitative forms, some of them resembling potatoes, and others taking discoidal forms, like the "clay stones" in the drift clays of New England. It gives origin to the bald knobs so frequently met with along the river bluffs, and are often rounded into natural mounds, which have been very generally used by the Indians as burial places for the dead. The bones of extinct mammalia are often found in the marly beds of this formation, and are associated with both land and fresh-water shells, which would indicate this to be a sedimentary accumulation in a fresh-water lake, or rather, series of lakes, into which the land shells and bones of land animals were carried by rivers, or smaller streams of running water. Bones of the Mammoth, the Mastodon, and the Casteroides, or fossil-beaver, have been found in this formation in this State, and also the flint arrows and other implements of primeval man.

Drift.—The lowest division of the Quaternary system comprises a series of variously colored clays, containing gravel and boulders, to which the term "Drift" is usually applied, because the materials of which it is composed have been transported, or drifted, to the region they now occupy. This appears to have been accomplished mainly by currents trending southwardly, for we find in the drift deposits water-worn boulders of all the rock formations outcropping over an area of four or five hundred miles to the northward, as far, at least, as the northern shores of the great lakes, from whence the granite, sienite and igneous boulders have come. Over a large portion of this county, especially adjacent to the river bluffs on either side of the county, the Drift is rarely exposed, from the thickness of the overlying beds of Loess, which cover it to the depth of from ten to fifty feet. In the central portions it is more accessible, and is pen-

etrated in digging wells, and all other excavations below the subsoil of the surface. Heavy beds of drift material cover the surface, overlying the Keokuk limestones in the vicinity of Perry, and extend southward through the central portions of the county, with a variable thickness ranging from twenty to forty feet or more. They are composed mainly of brown and yellow gravelly clays, which usually become bluish-gray towards the bottom, and enclose rounded boulders of metamorphic and igneous rocks, as well as those derived from the limestones and sandstones that constitute the paleozoic strata of our own and the adjacent States. Towards the river bluffs the drift deposits are not so thick, and at some points along the summit of the bluffs, they are wanting altogether, and the Loess rests directly upon the limestones. At many points in the State, beds of stratified sand and clay are found beneath the Drift, overlaid by the ancient soil which covered the surface anterior to the Drift period, but no shafts have been sunk, or other excavations made, so far as I am aware, in this county, deep enough to determine whether or not these Post Tertiary beds exist here. It is quite probable that they will be found in the central and northern portions of the county, as they are known to exist in the adjoining county on the north. At the base of the drift deposits, in the vicinity of Barry, there is a bed of clean yellow flint gravel, that is partly cemented by the oxide of iron into a ferruginous conglomerate, like that on the Ohio river, in Massac county, which has been considered as of Tertiary age. It was scarcely more than a foot in thickness where we saw it exposed.

Economical Geology.

Building Stone.—Pike county has an abundant supply of excellent building stone, which may be obtained from all the principal limestones that outcrop within its borders. The Niagara limestone in the vicinity of Pleasant Hill, furnishes a buff magnesian rock, in very regular beds, fully equal in quality to that afforded by the same beds at Grafton and Joliet. The upper ten or twelve feet of this formation is of this character, while the lower strata are of a gray color, contain less magnesia in their composition, and, although a durable stone, are not as easily worked as the rock from the overlying beds. A portion of the material for the construction of the new public school building at Pittsfield, which is one of the finest in the State, and reflects the highest credit on the people of that town, was brought from Joliet, while the same bed of limestone,

affording a material in every way equal to that from Joliet, outcrops within ten miles of Pittsfield. A want of the knowledge of this single fact has probably cost the citizens of Pike county far more than their proportion of the entire cost of the Geological Survey of the State.

The Burlington limestone, which outcrops over a wide area in this county, will furnish an unlimited supply of excellent building stone. The thickness of this formation is probably not less than one hundred and fifty feet, and nearly the whole of it may be made available, either as a building stone, or, if the beds are full of flinty material, as is locally the case, as an excellent macadamizing material for the construction of turnpike or common roads. The rock is usually a light gray or brown sub-crystalline limestone, and where free from flint or chert, is easily dressed and stands exposure well, being but slightly affected by atmospheric action. In the vicinity of Montezuma, the lower ten feet of the limestone exposed in the bluffs at that point is a massive gray rock, quite free from chert, and this lower division would afford dimension stone of any desirable size. Similar beds are exposed on Big Blue creek, four miles southeast of Pittsfield, where most of the rock required for use in the town was obtained. There is about forty feet in thickness of the rock exposed here, mostly in massive beds, from two to four feet thick. On the west side of the county it forms an almost continuous outcrop, from ten to forty feet in thickness, along the river bluffs, from the north line of the county to a point about two miles below Atlas, where it is cut off by the elevation of the upper Silurian strata, and on the east side it forms a continuous outcrop in the bluffs of the Illinois, from the vicinity of Griggsville Landing to the south line of the county. It also outcrops extensively on Bay creek, and all the smaller streams in the southern part of the county. This renders it easily accessible to all that part of the county south of Pittsfield, as well as the region adjacent to the river bluffs.

The lower portion of the Keokuk limestone, which immediately overlies the Burlington, is quite similar in character and appearance to the latter rock, and furnishes a building stone fully equal to that afforded by the Burlington limestone. It is usually rather free from chert at the principal points, where we found it well exposed, and excellent building stone is obtained at the quarries two miles north of Griggsville, on the south fork of McGee's creek. It differs from the Burlington rock more in color than in texture, being usually more inclined to a bluish-gray, but is semi-crystalline and highly

crinoidal, being almost entirely composed of the joints and plates of *crinoids*, cemented together by a calcareous paste. The bands of shale, or marly clay, which are usually found separating the strata of limestone at Nauvoo, Keokuk, and other northern localities, were not observed here, and hence in its outcrop it is not readily distinguished from the Burlington rock, except by a critical examination of the fossils which it contains.

The St. Louis group, although quite limited in this county, both in its development and outcrop, furnishes some excellent building stone. About a mile and a half northwest of Perry, there is an outcrop of about eighteen feet in thickness of massive brown magnesian limestone, that, for culverts, bridge abutments and foundation walls, especially where the rock is to be subjected to the combined action of frost and moisture, has no superior in the State. It contains considerable iron, which oxidizes freely, and gives to the surface a rusty brown color, which unfits it for use in the outside walls of fine buildings, where a pleasing exterior is desirable, but for all other uses it is a valuable and durable stone. This limestone was also met with just on the north line of the county, immediately north of Perry Springs, where a portion of the bed presented the same general character as at the locality above mentioned. It was only seen in the extreme northern portion of the county, in township 3 south, ranges 2 and 3 west.

Coal.—The coal deposits of this county are limited in their extent, and at all the points where coal has been found, with a single exception, the seams have proved to be too thin to be worked, except by the process of "stripping" or throwing off the overlying material, and working out the coal in open trenches. There are probably a good many points in the county where this may be done to advantage, in the valleys of the small streams where the coal seams outcrop, but the completion of the railroad from Naples to Hannibal will give access to the heavy coal seams east of the Illinois river, and thus supply the demands of this county for coal, at cheaper rates than could be done from the limited deposits within the county. At Huntley's mine, in the northwestern part of the county, the coal is six feet thick, and is worked by tunneling into the outcrop, for the supply of the adjacent region, but for reasons given on a preceding page, we are inclined to regard this as a local deposit, that will soon be exhausted. With this single exception, there is no coal known in this county that averages two feet in thickness over any considerable area, and the general range is only from sixteen to twenty inches.

Minerals.—No ores of any kind, except iron, were met with in the county. Carbonate of iron, as well as the bi-sulphuret, is found in the Coal Measures, and the former is a valuable ore for the production of iron, where it is sufficiently abundant, but no deposits of these ores were found in the county of sufficient thickness to justify the expenditure of capital or labor in attempts to develop them.

Limestones for Lime.—The best and purest limestone for the manufacture of quick-lime, will be found in the Keokuk and Burlington limestones. The upper or concretionary member of the St. Louis group, which is generally preferred for this purpose, was not met with in this county, and if found at all, would be too local in its development to supply any considerable portion of the county, but the limestones above named, one or both of them, are easily accessible at most points in the county, and when the rock is carefully selected they afford a very good material for this purpose.

Hydraulic Limestone.—Some of the upper beds of the Kinderhook group, in the vicinity of Mr. Churchill's place, just above the village of Kinderhook, presents the usual appearance of a hydraulic limestone, and a specimen of the rock analyzed by the late Mr. Henry Pratten, gave the following result:

Water	2.82
Silica	7.00
Alumina	0.77
Carbonate of lime	68.15
Peroxide of iron	0.77
Protoxide of manganese	2.11
Carbonate of magnesia	18.55

This analysis would seem to indicate too large a per cent. of carbonate of lime, and too small a proportion of the silicates of alumina and iron, to form a good cement rock, but further tests might show that the rock was well adapted for this purpose.

Clay and Sand.—The fire-clay which usually underlies the coal, if tolerably free from lime, is valuable for the manufacture of fire brick and common pottery, and where the coal seams are thin, it can be mined with the coal to good advantage. The brown clays of the Drift furnish an abundant material for the manufacture of common brick, and sand is abundant in the valleys of the streams. The Loess often affords these materials in just the right proportion for the use of the brick machine.

Marble.—The bed of oolitic conglomerate, already mentioned as occurring in the Kinderhook group at Rockport, receives a fine polish and makes a beautiful variegated marble. The bed, however, is only about three or four feet in thickness, and cannot be easily worked where it outcrops in the bluffs, on account of the thickness

of the beds which overlie it, but it may be found in some of the lateral valleys in the vicinity, where it could be quarried at less expense. Some of the sub-crystalline beds of Burlington limestone receive a high polish, and make a fine ornamental stone.

Mineral Springs.—Perry Springs are situated about two and a half miles southeast of the town of Perry, on a small branch of one of the tributaries of McGee's creek. The springs, three in number, issue from the upper part of the Keokuk limestone, which underlies the valley, and outcrops along the bluffs of the creek below the springs. They are about a hundred yards apart, and the upper one is called the Sulphur Spring, the middle one the Magnesian, and the lower the Iron Spring. The middle one is the most used, and affords the largest supply of water. They preserve a nearly equal temperature throughout the year, of about 48 to 50° Fahrenheit. An analysis of the waters of these springs, by Mr. HENRY ENGELMANN, as reported to the proprietors, Messrs. Watson & Divelbiss, gave the following amount of mineral matter, in grains, to each gallon of water:

	No. 1, or Middle Spring.	No. 2, or Upper Spring.	No. 3, or Lower Spring.
Bi-carbonate of lime	15.89	19.75	19.66
Bi-carbonate of magnesia	17.01	14.81	10.49
Bi-carbonate of iron	0.55	0.60	0.27
Silicate of alumina	0.00	0.00	0.27
Silicate of potassa and soda	2.64	2.28	3.45
Silicate of sodium	0.12	0.38	0.58
Sulphate of soda	0.44	1.10	1.49
Carbonate of potassa	1.59	1.45	1.26
	38.24	40.37	37.47

These springs are situated in a beautiful valley, surrounded by wooded hills, and afford a pleasant retreat for the invalid, and those desiring a temporary respite from the dust and turmoils of city life. They probably derive their mineral ingredients from the geodiferous shales of the Keokuk group, and a similar spring issues from about the same horizon at Warsaw, in Hancock county.

Soil and Timber.—The greater portion of the uplands in this county were originally covered with a heavy growth of excellent timber, but there are a few small prairies, seldom more than two or three miles in width, interspersed over its surface and occupying the most level portions of its area. The surface of the county is generally rolling, and in the vicinity of the streams becomes quite broken and hilly. The timber consists of white, red and black oak, pignut and shell-bark hickory, black walnut, elm, linden, wild cherry, honey locust, sugar maple, sassafras, etc. The soil on the prairies and more level timbered lands is a dark chocolate-colored clay loam, very productive,

and yields annually large crops of grass and all the cereals adapted to the climate. On the more broken lands along the streams the soil is lighter colored, and less productive, but well adapted to the growth of wheat, clover, and especially of fruit. The freshly cleared timbered lands are well adapted to the growth of tobacco, but it may be seriously questioned whether the best interests of the human race are promoted by its cultivation. On the river bluffs, and the region immediately adjacent thereto, where the Loess is the prevailing formation, the soil is more sandy and drains freely, and is well adapted to the cultivation of grapes and all other fruits adapted to the climate. The rich alluvial bottom lands on the western borders of the county have already been described on a preceding page.

In closing my report on this county, I desire to acknowledge my obligations to Dr. Benj. Norris, and Prof. Pike, of Pittsfield, for valuable information and voluntary assistance while we were engaged in prosecuting the survey of the county. To Dr. Norris the State Cabinet is also indebted for several valuable specimens of fossils and Indian antiquities from this county.

CHAPTER XIII.

ADAMS COUNTY.

This county lies upon the western border of the State, and is bounded on the north by Hancock county, on the east by Schuyler, Brown and Pike counties, on the south by Pike county, and on the west by the Mississippi river. It embraces an area of about twenty-three townships, or eight hundred and thirty square miles. It is well watered, having, in addition to the great river which forms its western boundary, several smaller streams, which afford a thorough surface drainage to all parts of the county. Bear creek drains the northern portion of the county; McGee's creek, the eastern and central; and McDonald's creek, Hadley's creek and Mill creek, intersect the southern and southwestern portion. These streams furnish a small amount of water power for mills and machinery, as well as an abundant supply of water for the stock grower. Fine springs of fresh water are abundant in some portions of the county, and more especially in the southern and western part, where the Burlington or Quincy limestone is the prevailing rock. This limestone is somewhat cavernous, and admits the free passage of subterranean streams through it, until they finally find an outlet at the surface, in limpid springs of cold limestone water.

The uplands in this county are nearly equally divided into timber and prairie, the timber portions being mainly restricted to the broken lands in the vicinity of the streams. The prairies are generally quite rolling, except in the northeastern portion of the county, where they are comparatively level. The general elevation of the prairie region, above the level of the Mississippi at low water, is from two hundred to two hundred and eighty feet. Along the western border of the county there is a belt of alluvial bottom land, from one to five miles in width, extending the whole length of the county, from north to south, except for about two mil in these

vicinity of the city of Quincy, where the bluffs approach near to the river bank. A portion of these alluvial lands are quite dry, being only overflowed by the highest floods in the river, and possess a very rich and productive soil, and are partially prairie, especially the higher portions adjacent to the river bluffs. The low bottoms are in part covered with a heavy growth of timber, embracing many varieties not found on the uplands. The bottom lands north of Quincy, towards the Hancock county line, are intersected with numerous bayous, and in the northeast corner of the county one of these widens into a lake four or five miles in length by about two in width, known as Lima Lake. The bottom lands in this part of the county are mostly too wet for cultivation, but below Quincy they are rather higher, and afford some fine farming lands, especially along the foot of the bluffs, where a considerable area is above the high water level of the river.

The geological formations exposed in this county comprise the lower Carboniferous limestone series, about three hundred feet in thickness, about one hundred feet of the lower part of the Coal Measures, and the Quaternary and Post Tertiary deposits of more recent age, which unconformably overlie all the others.

The following section will show the thickness and relative position of the formations exposed in this county:

	Feet.
Quaternary—	
Alluvium and loess	30 to 40
Drift clay, with gravel and boulders	80 to 90
Post Tertiary soil	2 to 6
Brown clay	6
Tough blue clay	20
Coal Measures—	
Beds of sandstone, sandy and argillaceous shale, with bands of limestone, bituminous shale, and fire-clay, with two or three seams of coal	100
Lower Carboniferous limestones—	
St. Louis group	40 to 50
Keokuk group	80 to 100
Burlington limestone	100
Kinderhook group, partly exposed	50

The Quaternary system properly includes all the deposits, both stratified and unstratified, that are of more recent origin than the Pliocene Tertiary. In this county we find a series of beds, comprising an aggregate thickness of about one hundred and sixty feet, which properly belong to this system. They include the surface soil and sub-soil on the uplands, and the alluvial deposits of the river valleys, the Loess, which is largely developed along the bluffs of the Mississippi, the Drift proper, including all the thick beds of unstratified clay and gravel, enclosing boulders of large size

and lastly, an ancient Post Tertiary soil and subordinate clays, usually distinctly stratified, and without boulders, which rest immediately upon the stratified rocks.

The soil at different localities rests upon, and is in part derived from, each of these subdivisions of the Quaternary system, and consequently varies considerably in its general appearance and productive qualities in accordance with the character of the beds on which it rests, and from which it has been mainly formed.

The alluvial deposits of the Mississippi Valley consist of partially stratified sands, alternating with dark bluish-gray or chocolate-brown clays, deposited by the annual floods of the river. In the vicinity of the bluffs, these deposits are annually increased by the wash from the adjacent hills, and the sediments that are carried down by the small streams during their frequent overflows.

The Valley of the Mississippi has been excavated in solid limestone strata, to the depth of from one hundred and fifty to three hundred feet or more, and from five to ten miles in width, and as we frequently find some portions of this valley still occupied by beds of unaltered Drift material, exactly like that which covers the adjacent highlands, we have undoubted evidence that it was not formed by the river which now in part occupies it, but is due to some other and more potent agency, dating back to a period long anterior to the formation of the existing water courses. It is very evident that the surface of the stratified rocks in this portion of the State has been subjected to the action of powerful denuding forces anterior to the accumulation of the superficial materials which now occupy the surface, by which these rocks were greatly eroded, and in many places cut into deep valleys, some of which now form our river courses, while others are wholly or partially filled with Drift and Post Tertiary beds, and it is highly probable that if we could see a complete section of the beds which now occupy these ancient valleys, we should find beneath the alluvial beds already described deposits even older than any which now cover the adjacent highlands. Along the banks of the water-courses, we find only from ten to twenty feet of the alluvial beds exposed by natural causes, and the character of the underlying strata can only be determined by artificial excavations.

The next older division of this system is the Loess, a deposit of marly sand and clay, which ranges in thickness from ten to forty feet, and attains its greatest development where it caps the river bluffs, thinning out rapidly towards the adjacent highlands, which form the summit level of the interior portion of the county. It is

usually of a light buff, brown or ashen-gray color, frequently showing distinct lines of stratification, and always overlies the drift clays when both are present in the same section. It is usually quite sandy where it caps the river bluffs, but becomes more argillaceous at other points where the beds are thinner, and locally, it becomes quite calcareous. The Loess is well exposed in the bluffs at Quincy, where it is about forty feet in thickness, and overlies some beds of plastic clay and sand, which are probably of Post Tertiary age, and older than the true Drift. Immediately above the limestone here, we fine a few feet in thickness of what might be called "local drift," consisting of angular fragments of chert, embedded in a brown clay, which have probably been derived from the subordinate limestones. This is overlaid by a few feet of blue plastic clay and stratified sands, on which the loess is deposited. At one point, near the base of the bluffs, in the northern part of the city, we observed underlying the Loess what seemed to be a chocolate colored soil, about a foot in thickness, which may represent the Post Tertiary soil penetrated in the shaft at Coatsburg, underlying the Drift deposits.

Here the true Drift is wanting, and the Loess directly overlies the older Post Tertiary beds. Notwithstanding the unsolidified character of this deposit, it is sufficiently coherent to present a vertical cliff where it is intersected by artificial cuts, and often remains for years in nearly perpendicular walls, where it has been cut through by running streams, or in grading the streets of the cities that have been built upon it. It is everywhere a fine sedimentary accumulation, and usually contains numerous terrestrial and fresh water shells, which, notwithstanding their fragile structure, are found entirely perfect, showing that they have not been subjected to any violent movements before they were buried in the marly sands of this formation.

The remains of the Mammoth, Mastodon, Megalonyx, Casteroides, and other extinct animals, occur in the Loess, indicating that it is a deposit formed in a fresh-water lake, into which the bones of land animals, and the shells of terrestrial molluscs were swept by the streams running into it from the adjacent land.

The term "Loess" was originally applied to a similar formation which caps the bluffs of the river Rhine, in Germany, and has been generally adopted by American geologists to designate beds that are similar in their character and origin to those on the Rhine, and that appear to have been formed at about the same time.

Drift.—This formation is composed of yellowish-brown or blue clays, with sand, gravel, and large boulders of water-worn rock, the whole mass usually showing little or no trace of stratification, and ranging in thickness from thirty to eighty feet or more. It is a heterogenous mass of water-worn fragments of all the stratified rocks that are known to occur for several hundred miles to the northward, embedded in brown or blue clays, and most of the large boulders which it contains are derived from the metamorphic sandstones, granites, sienites, porphyries, and other metamorphic and igneous strata that occur on the borders of the great lakes. Associated with these there are also rounded boulders, usually of smaller size, derived from the stratified rocks of this and the adjacent States. Fragments of native copper, galena, coal, and iron ore, are often intermingled with the general mass, but are not indicative of mines of those minerals in the immediate vicinity where such fragments are found, for they have been transported from other localities by the same powerful agencies to which the Drift formation owes its origin. The coal shaft at Coatsburg penetrated the thickest bed of Drift that has, perhaps, been found in this county, and I am indebted to Mr. Joseph Edwards for the following section of the beds passed through in sinking this shaft:

	Feet.	In.
Soil and yellowish clay	6	00
Bluish colored clay and gravel	45	00
Clay, with large boulders	40	00
Black soil	2	6
Clay, stratified	6	00
Very tough blue clay	20	00

We have in this section eighty-five feet of what may be considered true Drift, consisting of unstratified clays containing gravel and boulders. The upper six feet of the section probably represents the age of the Loess more properly than any other division of the Quaternary system, and its formation is explained by Prof. LESQUEREUX, in his chapter on the formation of the prairies, published in the preceding volume.

The ancient Post Tertiary soil, which was reached at a depth of ninety-one feet from the surface, and the stratified clays which underlie it, are of an older date than the Drift proper, and were no doubt formed under very different conditions. So far as we are aware, this was the first point in the State where a bed resembling the surface soil was observed below the Drift, as this shaft was sunk in 1859, but no public notice was made of it at that time, as it was then supposed to be a merely local phenomenon that might not be verified elsewhere. Fragments of wood, and also of bones,

were reported to have been found in it here, but we were not able to obtain specimens of them, and cannot vouch for the truth of the report. Subsequent discoveries at other points, however, show that wood, in an excellent state of preservation, is often found in this ancient soil, as well as in the underlying stratified clays; and in the shaft at Bloomington, at the depth of one hundred and eighteen feet, a considerable quantity of wood, some of which was perfectly sound, was taken from a similar deposit. These stratified clays, and the sands frequently associated with them, appear to have been entirely of fresh-water origin, the fossil shells which they have afforded being all of lacustrine or fluviatile species.

At Camp Point, a few miles east of Coatsburg, the Quaternary beds were all penetrated in sinking a tank well at the railroad station. They were here only sixty feet in thickness, but no note was made of the character of the different beds passed through. Probably the lower beds of stratified clays, and the ancient soil above them, were not found here, and the beds passed through were only the surface soil and sub-soil, and the true Drift deposits. From the soft and yielding character of the beds, a satisfactory natural section of them is rarely met with, and it is only where they have been penetrated in sinking coal shafts, wells, and other artificial excavations, that a correct section of the whole series can be seen. Along the breaks of the streams, the drift clays and subordinate beds of superficial material are generally eroded into sloping hillsides, covered with soil and vegetation, down to the fundamental rock on which they rest, and only very meagre exposures of the beds are to be found on the water courses.

Fossils are but seldom found in the Drift accumulations, and they consist entirely of the remains of mammalia; no shells, either marine or fresh-water, having yet been found in them in this State.

Carboniferous System.

All the paleozoic rocks that appear above the surface in this county, belong to this system, and comprise the lower portion of the Coal Measures, and the whole series of the lower Carboniferous limestones, except the Chester series, and the lower part of the Kinderhook group.

Coal Measures.—This term is applied to that portion of the Carboniferous system that contains the workable seams of coal, and

comprises shales, sandstones, bituminous slates, and thin bands of limestone, with seams of coal and the fire clays that underlie them. The whole thickness of these strata in this county probably nowhere exceed about one hundred and twenty feet, and they include the three lower coal seams, and the strata associated with them. The greatest development of this formation is in the northeast part of the county, on Little Missouri creek, where there is an exposure of some fifty or sixty feet of shales with two thin beds of limestone, above No. 2 coal, which is worked at different points in the valley of the creek.

The following section will show the general arrangement and thickness of the coal strata, as they are developed in this county:

	Feet.	In.
Hard, gray, nodular limestone	3 to 6	
Sandy shale and sandstone	25 to 30	
Black shale	2 to 4	
Coal No. 3, sometimes wanting	1	8
Fire-clay	2 to 3	
Clay shale	25 to 30	
Coal No. 2	2 to 3	
Fire-clay and clay shale	4 to 10	
Gray nodular limestone	4 to 5	
Shale	10 to 15	
Bituminous slate	1 to 3	
Coal No. 1	1½ to 2	
Shale and sandstone	20 to 30	

The middle coal seam in the above section (No. 2) is the most regular in its development, and furnishes altogether the best coal in the county. It outcrops on the south fork of Bear creek, and is worked by Mr. Ferguson, on the northeast quarter of section 17, township 1 north, range 6 west. The coal at this point ranges from two to three feet in thickness, and is of good quality, being generally quite free from the bi-sulphuret of iron. The roof is a bluish clay shale, of which about fifteen feet in thickness is exposed at the mine, above which there is a thin seam of bituminous shale and soft coal, indicating the horizon of another coal seam, which has been opened on another branch of the creek, about half a mile southeast of Ferguson's mine. The coal in this upper seam, which we refer to No. 3, is only from eighteen to twenty inches in thickness, and is full of iron pyrites, at the only point where it had been opened in this vicinity. It is overlaid by about two feet of black slate, and by eighteen to twenty feet of sandstone.

A mile and a half southwest of Ferguson's, on section 19, coal has been mined for several years, by stripping the seam along the valley of a small creek, a tributary of Bear creek, but the mines are now abandoned.

On Little Missouri creek, six miles northeast of Clayton, coal is dug in the same manner, by stripping the seam in the creek valley. The seam is here about twenty-eight inches thick, and the coal is of good quality. This is on section 12, township 1 north, range 5 west. On the southeast quarter of section 12, township 2 north, range 5 west, this seam has been worked on Cedar creek. The coal is here about thirty inches thick, and is underlaid by a white fire clay, and overlaid by fifteen or twenty feet of clay shale.

On the southwest quarter of section 31, township 1 north, range 5 west, about a mile southeast of Clayton, a thin seam of coal was opened in the early settlement of this part of the county, where the coal outcrops on a small branch of McGee's creek. The coal was found to be only from fourteen to sixteen inches thick, and was overlaid by four feet of black shale, which contained a few fossil shells, among which were *Discina nitida* and an *Aviculopecten*. This is, perhaps, coal No. 3 of the above section. On the northeast quarter of section 36, township 2 north, range 8 west, coal was dug at an early day on Mr. Higby's land. The coal was found here in the bed of a small creek, with no exposure of the beds associated with it, and was mined by stripping the seam of the overlying soil and clay. It was said to be from two to three feet in thickness, with six inches of blue clay shale, and about a foot of black shale above it. The coal was rather poor in quality, and is probably an outlier of the lower seam, No. 1. The coal was underlaid by sandstone, which was exposed near by, and a half mile southwest of this point the concretionary limestone of the St. Louis group was found *in situ*.

South of Clayton the country becomes quite rolling and hilly, but ravines seldom expose the bed-rock, and no coal is found outcropping, though it probably underlies most of the surface north of McGee's creek. After crossing this creek at Hughes' ford, coal is found in the bluff on the south side, on section 28, township 2 south, range 5 west, while below it are outcrops of the St. Louis and Keokuk limestones, the latter forming the bed-rock in the creek valley. The coal seam has been opened here by Mr. Luke Snow, at two points: one in the face of the bluff, where a tunnel has been commenced, and the other on a small ravine still further south, where the seam has been worked in an open trench on the outcrop. The coal is here from eighteen to twenty inches thick, and is overlaid by about two feet of bituminous shale, above which about six feet of clay shale was seen. The beds immediately below the coal were not exposed, but we are inclined to regard this as an

outcrop of the lower seam, No. 1. On the northeast quarter of section 31, township 2 south, range 5 west, there is an outcrop of coal that was known as Bassett's coal bank, and was worked at the time of our first visit to this part of the county, in 1853. The coal is here from sixteen to eighteen inches thick, and is overlaid by about two feet of black shale containing numerous fossils, among which were a large *Discina*, perhaps only a variety of *Discina nitida*, *Aviculopecten Coxana*, *A. pellucidus*, *Productus muricatus*. *Orthisina crassa*, *Orthoceras Rushensis*, and *Pleurophorus soleniformis*. On the southwest quarter of section 7, township 3 south, range 6 west, there is a similar outcrop of coal and bituminous shale, the latter containing the same fossils as at Bassett's. South of Liberty, and west of Kingston, coal outcrops at various localities on the head-waters of McDonald's creek, and before the construction of the C., B. and Q. Railroad the beds were worked quite extensively, and the coal hauled on wagons to supply the Quincy market. Since the construction of the railroad, however, coal can be more cheaply obtained from the mines in McDonough county, and those formerly worked in this part of the county have been generally abandoned. There is, however, a little coal still dug in this vicinity to supply the demands of the immediate neighborhood. An analysis of Bassett's coal, reported in Dr. Norwood's "Analyses of Illinois Coals," made by Mr. HENRY PRATTEN, gave the following results:

Specific gravity	1.2684
Loss in coking	42.52
Total weight of coke	57.48
	100.00

ANALYSIS.

Moisture	9.20
Volatile matters	33.32
Carbon in coke	51.48
Ashes (pale red)	6.00
	100.00
Carbon in coal	55.91

The Coal Measures in the south part of this county, as in Pike, are quite irregular in their development, and seem to assume the character of outliers from the main coal field. North of Columbus the three lower seams are found in their regular order, although not all equally constant in their development. Coal No. 2, or the Colchester seam, is by far the most constant, and will probably be found underlying nearly all of townships 1 and 2 north, in ranges 5 and 6 west, in this county, and may be reached by shafts at a depth varying from seventy-five to one hundred and fifty feet, according

to the thickness of the Quaternary beds at the different points. At Camp Point No. 2 was found at a depth of ninety feet, and at Coatsburg at 129 feet. Its general thickness is from two to two and a half feet, being about the same here as in McDonough county. The quality of the coal is good, but the seam seldom has a good roof, and, consequently, requires considerable expenditure for cribbing where the mines are to be worked permanently. South of Columbus there is no development of coal in this county that would justify the expectation of its ever becoming a valuable mining region, though considerable coal may be found in the vicinity of Liberty and Kingston, extending south to the Pike county line, perhaps sufficient for the local supply of that part of the county for some years to come. Mill creek, on the western borders of this region, and McGee's creek, on the east, show continuous exposures throughout their whole course of the lower Carboniferous limestones that lie entirely below the Coal Measures, and clearly define a horizon, below which no workable coal seam has ever been found. These limestones may be reached anywhere over the coal field in this county at a depth of from one to two hundred feet, and, when reached, a further search for coal, by going deeper, will only result in failure. In the northern portion of the county the Coal Measures rest upon the St. Louis limestone, and hence the outcrop of this rock is a valuable guide in determining the boundary of the coal area; but in the southwestern part of the county this limestone is not found, and the Coal Measures rest upon a lower division of the lower Carboniferous series, as they also do in Pike county. This has resulted from the erosion of the limestone strata before the Coal epoch, by which the upper beds have been wholly or partially removed, allowing the Coal Measures to rest unconformably upon the lower divisions of the series. But whenever any division of this limestone series is reached in searching for coal, it is entirely useless to extend the search below that horizon.

St. Louis Limestone.—This division of the lower Carboniferous series, as has already been remarked, usually forms the sub-stratum on which the Coal Measures rest, and will be found outcropping immediately below the sandstone which forms the base of the Coal Measures, in the northwestern, as well as the southeastern portions of the county. The upper division of this formation is usually a light-gray concretionary, or brecciated limestone, from five to twenty feet in thickness, below which there is usually a regularly bedded brown, or brownish-gray magnesian limestone, from ten to twenty feet thick, which locally becomes shaly, and passes into a calcareous

or argillaceous shale. The concretionary limestone sometimes contains irregular seams of green shale, or marly clay, disseminated through it, and at some point, as at Butt's Mill, on McGee's creek, is entirely replaced by green shales. At this point, there is about thirty feet in thickness of this group exposed, consisting of regularly bedded limestones at the base, passing upward into green and bluish colored shales, which are overlaid by ferruginous sandstone, the latter representing the base of the Coal Measures. On Waters' branch, a half mile south of this mill, there is a fine exposure of the regularly bedded limestone of this group, about ten feet thick, forming a perpendicular wall along the banks of the creek. There is a bed of earthy gray limestone about four feet thick, intercalated in it at this point, that appears like a hydraulic rock. The concretionary member of this group outcrops on the upper course of McGee's creek, three miles southeast of Columbus, and with the regularly bedded limestones below, continues along the bluffs of this creek, through its whole course in this county. In the vicinity of Hughes' ford, on section 27, township 2 south, range 5 west, the brown magnesian limestone of this series is well exposed, the bed ranging from ten to fifteen feet in thickness. It is about thirty feet above the bed of the creek, and overlies the geodiferous shales of the Keokuk group, which extend below the creek level. In the Coatsburg coal shaft, this limestone was reached at a depth of about one hundred and forty-seven feet, and the shaft was carried on through it, and into the geodiferous shales of the Keokuk group, where it terminated at a depth of about two hundred feet. On the Walnut fork of Mill creek, about four miles a little south of west from Columbus, this limestone is exposed on the southeast quarter of section 21, township 1 south, range 7 west, and as it is only about seven miles to its outcrop on McGee's creek east of that town, it is probable that it constitutes the bed rock entirely across the divide between these points, and separates the coal, south of Columbus, from that in the north part of the county. In the vicinity of Mendon, this limestone was met with at several points, and is overlaid by the coarse quartzose sandstone of the Coal Measures. Here the upper part of it is a light-gray, more or less concretionary rock, from ten to twelve feet in thickness, below which, we find the brown magnesian limestone, and the shaly beds, which form the lower division of the group. This limestone is also found well exposed on the tributaries of Bear creek, in township 2 north, range 8 west, and on the main creek, on its upper course, for some distance further east,

where it passes beneath the Coal Measures, and the latter becomes the bed rock over all the northwestern portion of the county.

This limestone may be readily distinguished from any of the lower divisions of the lower Carboniferous series, either by its lithological characters or the fossils which it contains. The light-gray concretionary limestone is characterized by two species of fossil corals, one or both of which may be found at nearly every locality where the rock is exposed, and are often met with in fine specimens, weathered out of the limestone, and lying in detached masses in the debris along the streams. They are generally siliceous, and where they have not been rolled and water-worn after being detached from the rock, they retain perfectly their original form and are frequently of a reddish-pink color from the siliceous matter which has replaced the carbonate of lime in the original coral. These corals belong to the genus *Lithostrotion*, and are known as the *L. mamillaris*, and *L. proliferum*, and the former species, which usually occur in massive forms, is popularly known as "petrified honey comb," from the polygonal form of the numerous calyces of which it is composed.

In the magnesian and shaly beds of this group, fossils are usually quite abundant, and among the most striking forms we may mention the screw-shaped fossil, known as the *Archimedes*, the axis of a perculiar form of *Bryozoa*. The largest form of this interesting genus, the *A. Wortheni*, of Hall, is found abundantly through the shaly beds of this group, and some of the largest specimens attain to a foot or more in length. Various other forms of *Bryozoa* also abound in this rock, and at some localities the magnesian beds of this group appear to be in good part composed of the delicate, reticulated remains of this class of organic forms. Marine shells are also abundant in the same beds, among which are *Spirifer lateralis*, *S. sub-æqualis*, *Rhynchonella mutata*, *R. subcuneata*, *Retzia Verneuiliana*, *Orthis dubia*, *Terebratula hastata*, *Platyceras acutirostris*, and *Productus Altonensis*. A knowledge of these species will enable the observer to identify this formation wherever it may appear, as some of them have a wide geographical range, especially the *Lithostrotion mamillaris* which is known to range from Illinois to Alabama, and, on a recent visit to Utah, we found it embedded in the highly metamorphic limestones of the Wahsatch mountains, within twenty miles of Salt Lake City. Hence we may understand the great value of fossils to the geological observer, as they enable him to establish the identity of strata at widely separated points, where

the lithological characters of the beds are completely changed, and where it would be impossible to trace the continuity of the strata.

Keokuk Group.—This group immediately underlies the limestone just described, and usually appears in two well-marked divisions. The upper one consists of bluish-gray or grayish-brown calcareo-argillaceous shales, and shaly limestones, enclosing siliceous geodes of various sizes, some of them a foot or more in diameter, a part of which are solid spheres of crystalline quartz, covered externally with a thin coating of chalcedony, while others are hollow, and have their inner surfaces covered with beautiful crystals of quartz, calcite, or dolomite, or with the mamillary forms of chalcedony. Crystals of arragonite, iron pyrites and zinc blende are also occasionally found in these siliceous geodes, and the finest cabinet specimens of the crystallized minerals above mentioned to be found in this State, are obtained from this bed. The shales and shaly limestones, in which the geodes were originally embedded, yield readily to the influence of frost and moisture, and the siliceous geodes are readily weathered out and may be found in great numbers in the beds of the small streams by which this formation is intersected. The Coatsburg coal shaft terminated in this bed at a depth of about two hundred feet below the surface, and we obtained several finely crystallized geodes here in 1860, from the material that had been thrown out of this shaft. This division of the group is about forty feet in thickness, and is well exposed on McGee's creek and some of its tributaries, and also on Bear creek and some of the smaller streams in the western part of the county. Locally, this portion of the group becomes quite calcareous, and the beds are then filled with the same species of fossil shells and corals that characterize the lower division. Another species of *Archimedes* much smaller than that found in the St. Louis group, called the *A. Owenana*, occurs both in the upper and lower divisions of this group, and is the oldest known form of this interesting genus of fossil *Bryozoa*.

The lower division of the Keokuk group consists mainly of bluish-gray limestones in quite regular beds, varying from six inches to two feet in thickness, separated by intercalations of buff or blue shale, or marly clay. Towards the base it is very thin-bedded and cherty, the flinty material predominating greatly over the calcareous. These beds are well exposed in the upper part of the quarries at Quincy, especially in the northern part of the city, where extensive quarries have been opened in these cherty beds, and also on the small creek at Whipple's mill, where they gradually pass upward into the more regularly-bedded limestones above. At Col. Jamie-

son's place, two miles northeast of Quincy, the regularly-bedded limestones of this group, the equivalents of the beds quarried at Nauvoo and Keokuk, are exposed, and higher up on the creek above mentioned, and a mile and a half further east, the quarries were opened in this limestone to furnish the foundation stone for Gov. Wood's mansion in Quincy. These quarries afforded an evenly-bedded, bluish-gray, semi-crystalline limestone, in beds from six to twenty inches thick, and furnished large slabs of dimension stone, from the facility with which the rock could be split into the desired form. The quarry rock at this point is directly overlaid by the brown shales of the geode bed.

From Quincy to the north line of the county this limestone outcrops at various points along the river bluffs, and is well exposed on Bear creek, near the Lima and Quincy road, where it forms a mural cliff from forty to fifty feet in height. It is also found on all the small streams in the west part of the county, as far south as Mill creek, and on both forks of that stream, though not on the main creek. The regularly-bedded limestones of this group are mainly composed of organic matter, and are formed from the calcareous portions of the molluscs, crinoids and corals, which existed in such countless numbers in the Carboniferous ocean during this period of the earth's history, as to furnish the greater part of the material required to form entire groups of limestone strata. All these animals secrete the carbonate of lime to form the habitations in which they live, and the solid integuments of their various parts and these calcareous fragments, cemented together by the chemical precipitation of the mineral matters held in solution by the waters of the ocean, now constitute many of the limestones and marbles out of which our cities are built, and which enter so largely, under various forms, into the economical uses of human life. The alternations of limestone with seams of clay or shales indicate the changing conditions that prevailed in the ocean at that time, as these clay seams are formed by the muddy sediments that at various times were introduced by currents or other causes into the ocean, which, settling to the bottom, formed the shaly sedimentary strata by which the limestones are separated. The characteristic fossils of this group occur almost everywhere that the rock is exposed. In the debris of the old quarries northeast of Quincy we found *Archimedes Owenana, Agaricocrinus Americanus, Actinocrinus pernodosus, A. biturbinatus, Spirifer Keokuk, Productus punctatus,* and *Zaphrentis dalii.* In

the quarries at Quincy we obtained *Aviculopecten amplus*, *Spirifer striatus*, and *Productus semireticulatus*, from the cherty beds at the base of the group.

Burlington Limestone.—This formation differs but little in its lithological characters from the lower portion of the Keokuk limestone, but it is usually of a lighter gray color, and contains intercalated beds of buff or brown limestone, while the bands of argillaceous shale, which separate the beds in the Keokuk group, are not seen in this. There is, however, one band of green clay, or clay shale, from one to six inches in thickness, intercalated in the beds at Quincy about midway from the bottom to the top of the exposure at the lower end of the city, where the beds are well exposed. At the quarries in the upper layers of limestone, opposite the steamboat landing, the cherty beds belonging to the Keokuk group are quarried, but in the lower part of the city the underlying limestones are well exposed, and are extensively quarried to supply the demand for building stone, and for burning into lime. The rock is tolerably even-bedded, and affords some layers two feet or more in thickness, which, when free from chert, may be cut with facility, and forms an excellent building stone.

The following is a section of the rocks exposed in the bluffs in the lower part of the city of Quincy:

	Ft.	In.
Loess capping the bluff	62	
Thin-bedded, cherty limestone (Keokuk)	13	
Light-gray limestone (Burlington)	12	
Band of green shaly clay (Burlington)	0	4
Buff and light-gray limestone (Burlington)	36	

The lower forty-eight feet of this section belongs to the Burlington limestone, and furnishes most of the building stone, and limestone for the manufacture of quick-lime, to supply the city and adjacent country. The light-gray limestones are a nearly pure carbonate of lime in their composition, and often contain pockets, lined with beautiful crystals of calcite. The buff and brown layers contain carbonate of magnesia and iron in small quantities, and some of the lower beds of this formation are highly magnesian, and approach a true dolomite in their composition. On Mill creek, at the old mill six miles southeast of Quincy, there is about forty feet of this limestone exposed, the lower part of which consists of alternating beds of light-gray and brown limestone, all of which are probably more or less magnesian in their composition, and afford an excellent building stone, comparatively free from chert and sufficiently massive to furnish dimension stone of any desired size. From this

point to the south line of the county this limestone forms continuous outcrops along the river bluffs, the exposures ranging from twenty-five to fifty feet or more in thickness. This limestone outcrops only over a limited area in the southwest part of the county, and a line drawn from the city of Quincy to the southeast corner of township 3 south, range 7 west, would represent very nearly its eastern boundary, while its western would be determined by the river bluffs. The quarries at Quincy have afforded a good many fine examples of the fossils peculiar to this group, among which the following are the most common species: *Spirifer plenus, S. Grimesi, Athyris lamellosa, A. incrassatus, Chonetes Illinoisensis, Productus semireticulatus, P. punctatus, Metoptoma umbella, Platyceras Quincyensis, P. biserialis, Actinocrinus Verneuilianus, A. oblatus, A. Hageri, A. Christyi, A. pyriformis, Granatocrinus Norwoodi,* and *G. melo.* From the lower beds of this limestone exposed in the river bluffs, between Mill creek and the south line of the county, we obtained *Actinocrinus carica,* a very rare species not yet found at any other locality in the State, *A. unicornis, A. clarus, A. discoideus, A. verrucosus, Strotocrinus umbrosus, Codonaster stelliformis,* and *Pentremites elongatus,* with three species of *Platycrinus* not yet determined. At Quincy we obtained a number of specimens of the remains of cartilaginous fishes, consisting of teeth and spines, and noticed one layer of limestone, in the upper part of the quarries, that was well filled with these fragmentary remains. The large spine, *Physonemus gigas,* figured on Pl. II, vol. 4 of the original Reports, was obtained from the quarries at Thayer's mill, about a mile below the city. The "fish-bed" of this division of the lower Carboniferous series was first noticed at Quincy, and a fine series of teeth and spines were obtained from it as early as 1854.

The fossil shells and crinoids above named are nearly all of them peculiar to this rock, and an acquaintance with them will enable the observer to distinguish this limestone from the Keokuk group, to which it is closely allied in its lithological characters, being largely composed, like that, of the calcareous portions of the marine animals that swarmed in countless numbers in the old Carboniferous ocean in which these limestones were formed. Nearly all of the purely calcareous strata of this formation are made up of the remains of marine animals, in which the *Crinoidea,* or *Encrinites,* largely predominate, and hence it has been called the *Crinoidal,* or *Encrinital,* limestone, by some of the early observers. It contains a good deal of chert, or flint, disseminated through it in seams and nodules, sometimes forming irregular layers between the limestone strata,

but more frequently in detached, nodular or ovoid masses in the limestones. These chert bands and nodules furnished the flints so much used by the Indians in the manufacture of spears, arrow-heads and other rude implements, and it was probably the most useful and valuable mineral known to them anterior to their acquaintance with the white man.

This limestone will be found at the base of the bluffs, for a few miles north of Quincy, but at so low a level as to be seldom exposed by the natural outcrop of the strata. On Mill creek it may be found for several miles up the creek, and on all the smaller streams, to the south line of the county, it forms the principal rock exposed.

Kinderhook Group.—Immediately beneath the Burlington limestone we find a series of sedimentary strata, consisting of sandy and argillaceous shales, and thin beds of impure limestone, only a portion of which appear above the surface in this county, to which the name Kinderhook group has been applied, from their fine exposure near the village of Kinderhook, in Pike county. The first considerable exposure met with in this county was at Fall creek, twelve miles below Quincy, where there is about thirty feet of this group to be seen in the creek bluffs beneath the Burlington limestone. The section here is as follows:

Burlington limestone	20 feet
Sandy shale and sandstone	20 "
Thin-bedded, siliceous limestone	10 "
Shale to the creek level	6 "

This formation is altogether about a hundred feet in thickness, and frequently has a bed of black or chocolate-colored shale intercalated in the lower portion, which has led many to the belief that coal might be found in it. This black shale was reached, in the boring made just below the city of Quincy, in search of coal, at a depth of about one hundred and fifty feet, but does not come to the surface anywhere in this county. As it lies nearly four hundred feet below any coal seam known in this county, all the time and money spent in the search for coal in this formation can only result in pecuniary loss and disappointment. This group is exceedingly variable in its lithological characters, and at some localities it becomes quite calcareous, and consists mainly of calcareous shales and magnesian limestones. The bed of siliceous limestone near the base of the above section may represent the light-blue or dove-colored limestone, called, in the Missouri Report, "Lithographic limestone," but at this locality it appears more like a stratified flint than anything else. Fossils are quite abundant in the siliceous gritstones at

Kinderhook and several points in Pike county, but none were found at the exposures on Fall creek. The outcrop of this formation in Adams county is restricted to the vicinity of the river bluffs from this creek to the south line of the county.

Economical Geology.

Bituminous Coal.—About one-half of the entire area of Adams county is underlaid by the Coal Measures, embracing the central and eastern portions of the county, and the strata developed here include the three lower coal seams and the beds usually associated with them, but the coal seams, except the middle one, are very irregular in their development, and therefore become of little value for the production of coal.

The middle seam, or No. 2, the equivalent of the Colchester coal in McDonough county, is generally quite regular in its development, and will be found underlying most of the region north and east of Columbus. Its average thickness is a little over two feet, though it frequently attains to thirty inches, and sometimes to three feet. The coal it affords is of a fair quality, and in some respects above the average of our western coals. The analysis of Bassett's coal, given on a preceding page, will serve to indicate the quality of the coal obtained from the southern part of the county, and may be compared with the following analysis of Higby's coal, two miles north of Mendon, which I believe to be an outlier of Coal No. 1. This analysis was made by the late Mr. Henry Pratten, and is given in Norwood's "Analyses of Illinois Coals:"

Specific gravity	13.354
Loss in coking	48.4
Total weight of coke	51.6
	100.0

ANALYSIS.

Moisture	10.0
Volatile matters	38.4
Carbon in coke	41.2
Ashes (yellow)	10.4
	100.0
Carbon in coal	48.0

This is a heavier coal than that from No. 2, and contains about seven per cent. less of fixed carbon, according to the analysis here given. The coals from Nos. 1 and 3 are usually inferior in quality to that obtained from No. 2, and the two former are not likely to be found sufficiently persistent in their development in this county

to be of any great economical value for the production of fossil fuel. Over all the northeastern portion of the county, No. 2 has been found wherever the Measures have been penetrated to the proper depth, or where the right horizon has been exposed by natural causes. The principal drawback to the successful mining of this seam is the shaly character of the roof, which is usually a blue clay shale, though it has been seen at a few localities where it was overlaid by a bituminous shale, which forms a good roof. This coal seam will afford, according to the usual mining estimates, about two million tons of coal to each square mile of surface which it underlies, and although at the present time there is but little demand for coal except along the railroad lines, yet the time is not very remote when a good coal, two feet or more in thickness, will be considered of sufficient value and importance to be opened wherever it can be reached at a depth not exceeding one hundred to one hundred and fifty feet below the surface.

Building Stone.—All the principal limestone groups of this county furnish more or less building stone of good quality, and there are but few points in the western part of the county where some of them are not easily accessible in the bluffs or valleys of the streams. The Burlington limestone, which is extensively quarried at Quincy, is one of the most important and valuable deposits of building stone in the county, and as its aggregate thickness is about one hundred feet, nearly all of which may be used as a building stone, the supply from this formation alone might be fairly considered as inexhaustible. It is for the most part a light-gray or nearly white semi-crystalline limestone, which cuts easily when free from chert, and is an excellent stone for dry walls, as well as for caps and sills, and all the ordinary purposes for which cut stone is required. The buff and brown layers contain a small per cent. of iron and magnesia, and the surface becomes more or less stained by long exposure, but the light-gray beds are a nearly pure white carbonate of lime in their composition, and generally attain their original color. The lower portion of the Keokuk limestone is similar to the Burlington in its composition, but is usually of a little darker bluish-gray color. The brown magnesian limestone of the St. Louis group is an evenly stratified rock, admirably adapted for common use in foundation walls, and especially for bridge abutments and culverts, where a rock is required to withstand the combined action of frost and moisture. This rock may be found in the bluffs of McGee's creek, through nearly its whole course in this county, and also on Bear creek and its tributaries, in the northwest part of the county.

The bed is variable in thickness, ranging from five to twenty feet, and it often affords massive strata from two to three feet thick. In the vicinity of Furguson's coal bank, four miles northwest of Camp Point, there is an outcrop of brown sandstone overlying coal No. 3, which seems to stand exposure well, as it forms a mural cliff, nearly twenty feet high, along the creek for some distance, and would probably make a durable building stone. There are but few counties in this State where good building stone is so abundant, and easily accessible to all parts of the county, as here.

Limestone for Lime.—Most of the limestone used in the manufacture of quick-lime is obtained from the Burlington limestone, in the vicinity of Quincy, and a large amount of this article is produced annually, for the supply of the city and the adjacent county. The light-gray beds of the Burlington, and the bluish-gray strata of the Keokuk group, are either of them sufficiently free from siliceous or other foreign material, when carefully selected, to produce a quick-lime of excellent quality. The upper or concretionary bed of the St. Louis group is also, at many localities, a very pure carbonate of lime, and may be found useful for this purpose in the eastern portion of the county, where the underlying formations are not accessible. Its outcrop is mainly around the borders of the coal formation, immediately below the sandstone conglomerate which usually forms the base of the coal series.

Fire and Potters' Clays.—The under clays of coal seams No. 1 and 2 are usually of good quality, and where the strata are of sufficient thickness, they become valuable deposits of fire-clay, and may be successfully worked in connection with the coal seams. At some points there is a bed of fine light-blue clay shale, intervening between these two coal seams, which, on exposure, weathers to a fine plastic clay, and forms an excellent potters' clay. This is the bed from which the clays used in the potteries at Ripley, in Brown county, have been obtained. This bed of clay shale is exposed at various points in this county, and will furnish an abundant supply of potters' clay, while the under clay of No. 2 may be used for the manufacture of fire-brick.

Clay and Sand for Brick.—The sub-soil clays of this county, intermingled with the fine sand of the Loess, form an excellent material for the manufacture of common brick, and may be obtained almost anywhere in the western part of the county; and there are but few points in the State that have produced as good an article of common brick as has been manufactured for many years in the vicinity of Quincy. In the eastern part of the county, where the Loess is

wanting, the sand for this purpose may be readily obtained in the alluvial valleys of the small streams. These materials are so universally abundant, that almost every farmer in the county may find them at hand upon his own premises, for the manufacture of all the brick required for building purposes.

Soil and Timber.—As an agricultural region, this county is not surpassed by any other portion of the State of the same geographical area. The western portion of the county, including a belt of country from five to ten miles in width, adjacent to the river bluffs, and extending through its entire length, from north to south, is underlaid by the marly sands and clays of the Loess, and possesses a soil of remarkable fertility, with an undulating surface, which furnishes a free drainage, so that, with a rather porous sub-soil, it is less subject to the deleterious influences of remarkably dry or wet seasons than the other upland soils of the county. The growth of timber on this variety of soil consists principally of red, white and black oak, pig-nut and shell-bark hickory, elm, black and white walnut, sugar maple, linden, wild cherry and honey locust. These lands are admirably adapted to the growth of fruit, and this portion of Adams county has been long and favorably known as one of the finest fruit regions in this portion of the State.

On the breaks of Mc'Gee's creek, and its tributaries, the surface is considerably broken, and the soil, which is mainly derived from the Drift clays, is a stiff clay loam, better adapted to the growth of wheat and grass than almost any other crop usually grown in this latitude. The growth of timber on this kind of soil consists mainly of two or three varieties of oak and hickory, which is the characteristic growth of the "oak ridges" that are so frequently met with on the small streams, in this and other portions of the State. In the northeastern portion of the county there is a considerable area of comparatively level prairie, covered with a deep, black soil, highly charged with vegetable matter, derived from the annual growth and decay of the shrubs and grasses which clothe its surface. This black prairie soil is predicated upon a fine siliceous brown clay sub-soil, which does not permit the surface water to pass freely through it, and hence these lands suffer greatly from a surplus of water during a wet season. They are very productive, however, when the season is favorable, and produce abundant crops of all the cereals usually grown in this latitude. A judicious system of drainage would add greatly to the productive capacities of this soil. The alluvial bottom lands bordering the Mississippi are generally similar in their character to those in Pike county, and are heavily tim-

bered with the same varieties mentioned in describing the bottom lands of that county in the preceding chapter. Where these bottom lands are elevated above the annual overflow of the river, they are exceedingly productive, and rank among the most valuable farming lands in the county.

CHAPTER XIV.

BROWN COUNTY.

This county embraces a superficial area of only about eight and a half townships, or three hundred and six square miles, and is bounded, on the north, by Schuyler county; on the east, by Crooked creek and the Illinois river; on the south by Pike county; and on the west, by Adams county. This county is well watered by the two streams already mentioned as forming its eastern boundary, and by McGee's creek, which traverses the southern part of the county, giving a complete surface drainage to its entire area. The general surface level of the uplands ranges from one hundred to two hundred and fifty feet above the level of the principal streams, and a large portion of it was originally covered with a heavy growth of timber. The upland prairies are small, and mostly confined to the middle and western portions of the county. The bottom lands on the eastern border of the county are mostly prairie, with belts of timber immediately adjacent to the water courses.

The uplands are generally rolling, and in the vicinity of the streams the surface is cut into sharp ridges, separated by narrow valleys. The best soils upon the uplands are those underlaid by the Loess, and are characterized by a heavy growth of the common varieties of oak and hickory, elm, sugar maple, black walnut, linden, wild cherry, honey locust, etc., and are restricted to the vicinity of the Illinois river bluffs. In their productive qualities, these lands are fully equal to the best prairie soils. Further west, on the tributaries of Crooked creek and McGee's creek, the timber is mainly oak and hickory, including two or three varieties of each, and the soil is generally a heavy clay loam, derived mainly from the brown clays of the Drift formation. The prairie soil is usually a dark chocolate clay loam, highly charged with humus, especially on the level portions, where the annual

accumulations of animal and vegetable matters have been retained, and in its productive qualities it ranks next to the timbered soils of the Loess. It rests upon a sub-soil of argillaceous loam, which is also rich in the phosphates and carbonates essential to the growth of vegetation, and will furnish the essential elements to replenish the surface soil, when it becomes exhausted by a long continued and injudicious system of cultivation.

The bottom lands adjacent to the Illinois river possess a light sandy soil, and when sufficiently elevated to be susceptible of drainage, and are protected from the annual overflow of the river floods, they are very productive. The timber of the bottom lands consists of cottonwood, soft maple, linden, ash, elm, black and white walnut, pecan, hackberry, sycamore, swamp white oak, burr oak, Spanish oak, coffee-nut, shell-bark hickory, honey locust, wild plum, crabapple, dogwood, etc. Although much of this land is now too wet for cultivation, being subjected to overflow from the periodical floods in the river, yet its surface is constantly rising, from the accumulations of sediment left by the river floods, and by the material constantly being deposited upon it by the wash from the neighboring highlands. Thus the hills are being leveled, and the valleys filled up, a process constantly carried on now, as in all past time, by which, in the coming ages, every portion of the earth's surface will become fitted for man's use, and be made subservient to his interest. Every year adds to the area of tillable land on our bottoms, and the time is not very distant when their entire surface will be susceptible of cultivation.

Geology.

The geological formation of Brown county comprises the Quaternary, the lower portion of the Coal Measures, including the three lower coal seams, and the two upper divisions of the lower Carboniferous limestones, as they are developed in this portion of the State. The following section will show the relative position and thickness of the formations above named, as they appear in this county:

	Feet.
Quaternary system, including Alluvium, Loess and Drift	80 to 110
Coal Measures	130 to 140
St. Louis limestone	30 to 40
Keokuk group	40 to 60

The Quaternary system includes all the superficial beds of soil, sand, clay, gravel, etc., which cover up all the older formations, except along the streams where the lower Carboniferous limestone

has been laid bare by the action of running water. It is the newest, or last formed of all the geological systems, and includes among its fossils only the living species of animals, and those closely allied to them. The term, Alluvium, includes the surface soil and subsoil of the prairies, and the bottom lands along the borders of our rivers and smaller streams. Possibly, the former may correspond nearer, in the time of its formation, with the Loess, than with the deposits of the river valleys, but it has generally been considered as coincident with the latter, in its formation, and hence of Alluvial age. The Alluvium of the Illinois river valley, like that of the Mississippi, consists, so far as we may judge from the exposures in the banks of the river and the small streams by which it is intersected, of sands, clays, and vegetable mould, more or less perfectly stratified, and frequently replacing each other at short intervals. It has been formed, in part, from the transported material brought down by the river current, together with the vegetable and animal substances that decay upon the surface, to which is added, the sands, clays, and organic matter, that is washed down upon it from the neighboring hills.

The Loess is restricted to the region adjacent to the Illinois river bluffs, and attains a maximum thickness of nearly a hundred feet, but thins out gradually from the bluffs towards the central portions of the county. It consists of brown and drab-colored sandy and marly clays, sometimes partially stratified, and varying in color with the variable quantities of the oxide of iron it contains. It is well exposed in the vicinity of Versailles, and forms the main portion of the hills adjacent to that town, and is exposed in the cut along the Quincy and Toledo railroad, westward, nearly to Harsman Station. At LaGrange the Loess and Drift formations overlie the Coal Measures, and are, by measurement, one hundred and ten feet in thickness, the greater portion of which may be included in the Loess. It contains here a few of the land and fresh-water shells, which are the most characteristic fossils of this group at other points, but they are less abundant here than at Quincy and many other localities in the State.

The Drift formation in this county presents the same general characters as in the adjacent counties, and consists of unstratified clay and gravel, usually of a brown or ashen-gray color, containing boulders of igneous and metamorphic rocks disseminated through it, but most abundant in the lower portion of the deposit. As no rocks similar to these boulders are to be found within the limits of this State, it is evident that a large portion of the material composing

this formation has been transported from abroad, and by comparing specimens of these boulders with the nearest known outcrops of similar rocks *in situ*, it has been demonstrated that much of this material has been derived from the region to the north of Lake Superior.

The transportation of this Drift material has been brought about by the combined agencies of ice and water, during a period of submergence, while the entire area of this and several of the adjoining States was beneath the water level. Icebergs, impelled by winds or currents of water, and loaded with the detritus of distant shores, were no doubt one of the most potent agencies in the accumulation of the drift, and we find, as we trace this deposit southward from the Lake Superior region, that the boulders diminish in size and number, in that direction, until they entirely disappear.

When we consider the conditions under which the Drift formation has been accumulated, it seems hardly possible that valuable mineral deposits could be found in it; and although we occasionally do find specimens of native copper, gold, and the ores of lead, iron, etc., in it, it is quite impossible, from the conditions under which the drift has been accumulated, that it should contain any valuable deposits of these or any other metals or metallic ores. Small quantities of native gold are reported to have been found in the gravel and drifted clays of this and the adjoining counties, and possibly this may be true, but it is far more probable that the substance mistaken for gold was yellow mica or iron pyrites, derived from the Coal Measures which form the bed-rock over a large portion of the county. These substances are often mistaken for gold by those who have no acquaintance with mineralogy, and most of the announcements made through the public press in regard to gold discoveries have no other basis than the chance discovery, by some uninformed person, of one of the substances above named, coupled with their firmly expressed opinion that it is *pure gold*.

Although gold is frequently found in the gravel beds of the streams in the auriferous regions, it is usually in close proximity to the gold-bearing rocks from which the precious metal has been derived, for the specific gravity of gold is so great that it is rarely transported for any considerable distance from the outcrop of the metamorphic rocks in which it occurs. The search for gold in the Drift deposits of this State could scarcely result otherwise than in disappointment and pecuniary loss to those who may engage in it,

and the geologist who, for a temporary notoriety, should encourage such on enterprise, would sooner or later receive his just reward in the contempt of all honest men.

Carboniferous System.

Coal Measures.—This term is usually applied to a group of strata, consisting of sandstones, shales, slates and thin beds of limestone, with the coal seams and fire clays with which they are associated. Only the lower portion of this group is found in this county, including the three lower coal seams and the strata associated with them. The highest beds of this group are found in the vicinity of Mount Sterling, where a hundred feet or more of strata may be found outcropping on the small creeks which run northward into Crooked creek. A section of these beds, down to the horizon of No. 2 coal, shows the following order:

	Feet.
Nodular gray limestone, partially exposed	5 to 10
Shale	20 to 30
Black shale	4
Purple shale	0.6
Coal No. 3?	1.3
Shale and fire clay	15 to 20
Rough gray limestone, passing into a ferruginous conglomerate	4 to 6
Sandstone and sandy shale	15 to 20
Blue argillaceous shales	30 to 40
Shaly calcareous sandstone, with fossils	3 to 4
Argillaceous, or bituminous shale	8 to 10
Coal No. 2	1½ to 2½
Fire-clay	2 to 3

This lower coal seam is worked at several points northeast of Mount Sterling, in open trenches, along its outcrop in the valleys of the small streams. Four miles northeast of that point it is worked in this way by Mr. Miller, on a branch of Curry creek. The coal is about two feet in thickness, and of good quality, with about five feet of clay shale in the roof, above which there is a bed of black shale that, at some other localities in this vicinity, rests directly upon the coal. Two miles north of Mount Sterling a shaft was sunk by Mr. Graves to the depth of about ninety feet, when he struck the coal worked in this vicinity at that depth. The seam was found to be from 28 to 30 inches thick, which was not deemed sufficient to assure a paying investment in coal mining at this point, and the shaft was subsequently abandoned. Another shaft was sunk near Mound Station, with a similar result.

On the Little Missouri creek, in the northwest corner of the county, on section 7, township 1 north, range 4 west, coal is dug at

many points in the ravines which intersect the bluffs of the main creek. The coal ranges in thickness here from 24 to 30 inches, and is overlaid by clay shale containing plants, and otherwise presents the usual characteristics of No. 2 coal. A section of the strata exposed in this vicinity shows the following order of succession:

	Feet.
Sandy shales	8 to 10
Evenly-bedded sandstone	8
Black shale	3
Limestone	4
Clay shale	25 to 30
Coal	2 to 2½

The black shale in this section may represent the horizon of coal No. 3, and if so, then the thin seam near Mount Sterling, which we have marked No. 3, with a query, is probably a local development. This seems most probable, as it presents none of the usual features of either Nos. 3 or 4, and we have seen no other outcrop of coal, either in this or the adjoining counties, that we can identify with this. If it represents No. 3, there is a great thickening of the strata at this point, for this coal is not usually more than forty or fifty feet above No. 2, whereas in the section near Mount Sterling the thickness of the intervening strata is from seventy-five to one hundred feet.

At the LaGrange bluff, on section 29, township 1 south, range 1 west, the lower part of the Coal Measures are well exposed, resting upon the St. Louis group, consisting of limestones and calcareous sandstones, which outcrop at the base of the bluff. The following beds of the lower Coal Measures outcrop at this locality:

	Ft.	In
Shale	10	
Band of iron ore, with fossils	0	4
Shaly clay	3	
Limestone	1	
Bituminous shale	2	
Coal	2	6
Shaly fire-clay	4	
Compact nodular limestone	4 to 6	
Shaly clay	15	
Ferruginous sandstone	15	

The horizon of coal No. 1 in the foregoing section is between the ferruginous sandstone and the bed of clay shale which overlies it, but no trace of coal was to be seen where this section was made. A little further to the northward coal is said to have been found near the base of the bluff, and if so it must have come from seam No. 1. The upper shale in the foregoing section contains a calcareous band in the lower part of the bed, which is filled with fossil

shells, among which we observed *Productus muricatus* and *Chonetes mesoloba*, and these species were also found in the band of iron ore below. The compact and nodular limestone below the coal contains several species of univalve shells, belonging to the genera *Naticopsis*, *Pleurotomaria* and *Murchisonia*.

The clay shale below this limestone affords the potters' clays so extensively used in this county in the manufacture of pottery, and its average thickness is fifteen feet. At Ripley the same beds are exposed as at LaGrange, and show but little variation in their lithological characters, as may be seen from the following section at that point:

	Ft.	In.
Micaceous sandstone	4 to 6	
Argillaceous shale	4	
Bituminous shale	3	
Coal No. 2	2	
Fire-clay and shale	6	
Nodular bluish-gray limestone	5	
Light-gray clay shale (potters' clay)	15	
Bituminous shale (Coal No. 1)	3	
Ferruginous clay	0	6
Quartzose sandstone	20	

The bed of sandstone at the base of this section represents the conglomerate, which usually forms the base of the Coal Measures and is quite variable in thickness, ranging in this county from five to twenty feet, though it is frequently wanting altogether. For three or four miles south of LaGrange this sandstone outcrops in a continuous mural bluff from fifteen to twenty feet in height, and when the lower coal (No. 1) is developed at all it will be found immediately above this sandstone.

From the preceding sections a general idea may be had of the thickness and lithological character of the Coal Measures, as they are developed in this county, and it only remains now to speak of the extent of surface which they underlie. Originally they covered the entire area of the county, but in the subsequent excavation of the valleys of the Illinois river and its main tributaries the whole thickness of Coal Measure strata have been cut away down to the underlying lower Carboniferous limestones, into which all the principal streams have cut their channels along the lower portion of their courses. Hence, the Coal Measures are now found only beneath the surface of the highlands and in the valleys of the smaller streams; but they underlie nearly all the uplands in the county, except a limited area in township 2 south, and range 2 west, in the vicinity of Versailles, where the hills consist of Loess. In this vicinity the Coal Measure strata have been removed by the same

agencies that scooped out the main river valley, and the bluffs here are formed by the Quaternary deposits that were subsequently deposited in and now partially fill this ancient valley.

The principal coal seam developed in this county is No. 2, or the Colchester seam of McDonough county, and it outcrops on most of the small streams, and may be reached by shafts almost anywhere on the uplands in the central, northern or western portions of the county, at a depth varying from one hundred to one hundred and fifty feet.

St. Louis Group.—This group forms the upper division of the lower Carboniferous series in this portion of the State, and consists of a hard gray concretionary limestone, varying from five to ten feet or more in thickness, which constitutes its upper division, and a brown magnesian limestone and calcareous sandstone, with some intercalations of blue clay shale, which form the lower division of the group. Its entire thickness in this county may be estimated at about forty feet. We found the upper division well exposed on the Dry Fork of McGee's creek, six miles south of Mount Sterling, at Tucker's old mill. The rock is here an irregularly-bedded gray limestone, a portion of which is stained a deep rusty-brown color, by the decomposition or oxidation of the crystals of iron pyrites which it contains, and it also contains irregular seams of green marly clay. We obtained a few fossils from the beds at this locality, among which were *Lithostrotion proliferum*, *Archæocidaris Wortheni*, and *Granatocrinus cornutus*. The last named species has not been found at any other locality in the State. In the bluffs of McGee's creek, about a mile and a half below Jaqueth's mill, there is an exposure of almost thirty feet of buff and brown magnesian limestone and shale which belong to this group, and at the mill are found the following beds overlying the blue geodiferous shales of the Keokuk group:

	Feet.
Fine-grained greenish sandstone	6
Brown shale	12 to 15
Brown magnesian limestone	8 to 10

In the river bluffs, about two miles southeast of Versailles, the brown magnesian limestone, which forms the lower division of this group, is exposed in the face of the bluff, and a quarry has been opened in it, showing about fifteen feet in thickness of regularly-bedded limestone, which forms an excellent building stone. This quarry is about fifty feet above the level of the Illinois bottoms.

At LaGrange, there is from twenty-five to thirty feet of this group exposed at ths base of the bluff. The upper portion is a gray limestone about six feet thick, below which there is about twenty feet, consisting of alternations of brown magnesian limestone, with calcareous sandstones and shales. The magnesian limestone at this point is not as evenly-textured as this rock usually appears, and some of the layers crumble readily on exposure to atmospheric influences. This group is also exposed on a small creek five miles west of LaGrange, on the Mt. Sterling road, the upper bed consisting of gray concretionary limestone, while the lower part is a brown magnesian limestone, altogether about fifty feet in thickness. The general outcrop of the St. Louis group in this county is along the valleys of Crooked creek and McGee's creek, and on some of their principal tributaries, and also along the base of the Illinois river bluffs, wherever the stratified rocks are exposed. In the vicinity of Ripley, we find this group outcropping in the bluffs of Crooked creek, affording, with the underlying shales of the geode bed, the following section:

	Feet.
Concretionary limestone	10
Brown magnesian limestone	15
Blue argillaceous shales, partly exposed	25

The two upper beds in the above section belong to this group, while the lower, which at this locality was only partly exposed, belongs, for the most part at least, to the underlying Keokuk group. The magnesian limestone and the calcareous sandstone of the St. Louis group, furnish the most durable building stone to be found in the county.

Keokuk Group.—Only the upper part of this group appears above the surface in this county, including the geodiferous shales and a few feet in thickness of thin-bedded limestone. These beds are exposed on the lower course of McGee's creek, and also on Crooked creek, along its whole course in this county. At Chambersburg, the thin-bedded limestone which underlies the geodiferous shales may be seen in the bed of McGee's creek, and they have afforded a few of the characteristic fossils of this formation, among which were *Agaricocrinus Americanus*, *Archimedes Owenana*, and *Spirifer Keokuk*. This limestone outcrops along the bed of the creek, at intervals, as far west as township 1 south, range 5 west, in Adams county, the easterly dip of the strata corresponding very nearly to the fall of the creek.

At Jaqueth's mill, about six miles a little south of west from Versailles, the geodiferous shales of this group are well exposed, forming

the base of the bluff, as shown in the following measured section, made at this point:

	Feet.
Fine-grained sandstones	6
Brown shales	10 to 15
Brown magnesian limestone	8 to 10
Blue shales, with geodes	35 to 40

The lower bed in the above section consists of blue argillaceous shales, traversed by perpendicular veins of satin spar, from a quarter of an inch to an inch in thickness. The geodes from this locality contain beautiful crystals of brown and colorless calcite, dog-tooth spar, zinc blende, dolomite, iron pyrites, and the more common forms of crystallized quartz and chalcedony. They are mostly of small size in the bluff at the mill, but at other points they are larger and are mostly lined with quartz crystals. The regularly-bedded gray limestones, which form the lower portion of this group, do not appear above the surface in this county, but would be found a few feet below the level of the main water-courses.

Economical Geology.

Coal.—As has already been stated, the Coal Measures underlie nearly all the uplands in this county, and attain a maximum thickness of nearly one hundred and fifty feet, including the horizon of the three lower coal seams. Only one of these, however, No. 2, or the Colchester coal, of McDonough county, appears to be generally developed in this county, and from this, nearly all the coal mined at the present time is obtained. We found this seam very uniform in its thickness, and apparently extending over nearly the whole area underlaid by the Coal Measures. It affords a coal of good quality, and the only draw-back to the success of coal mining enterprises in this county is the thinness of the strata, which varies from twenty-four to thirty inches. The roof is generally a clay shale, though, at some localities, the lower part of it becomes highly bituminous, passing into a black shale, which forms an excellent roof. This seam is only worked in a very primitive way, by the process called "stripping," which consists of throwing off the overlying material, where the coal outcrops in the valleys of the small streams, and then taking out the coal where the seam has thus been laid bare. This seam is as thick here as it is in the vicinity of Colchester, where it is successfully worked, both by tunneling into the hillside along its outcrop, and by shafts sunk to the level of the coal in the highlands. It will furnish about two million tons of

coal to the square mile, and probably underlies at least two-thirds of the area of the county.

Coal seam No. 1 is quite irregular in its development, and at most points where we found the horizon of this coal exposed, we found the coal replaced by a thin bed of bituminous shale. Just above LaGrange, we were told that a seam had been formerly opened at the foot of the bluff, where the coal was about two feet thick, and if so, it must have been the lower seam. We also found an outcrop, at about the same horizon, on Little Missouri creek, near the north line of the county, on section 5, township 3 south, range 4 west, where the coal was about two feet thick, which, probably, is an outcrop of No. 1. It generally affords an inferior coal to that produced from the seam above it, and for that reason it will not be as extensively worked as the other seam, even when found of the same thickness.

The thin seam which outcrops a little northeast of Mount Sterling, may be the representative of No. 3, and if not, is a local development of coal, coming in between Nos. 3 and 4. It is the only seam met with in the county above No. 2, and its distance above that may be due entirely to a local thickening of the intervening strata. But, in the absence of the characteristic fossils that are usually found in connection with No. 3 coal, it is difficult to decide positively whether this seam should be considered as the equivalent of that, or as holding a high position. However, as it is probably nowhere developed of sufficient thickness to be successfully worked, the question has no important practical bearing in estimating the coal resources of the county. No coal will be found here below the beds of the main water courses, as we have already stated that these have been cut down quite through the Coal Measures, and into the upper division of the lower Carboniferous limestone series, which underlies all the coal strata at present known in this county.

Potters' Clay.—This county has long been noted for the amount of potters' ware annually manufactured within its limits. The potteries are mostly located in the vicinity of Ripley, though the bed of clay shale, which furnishes the material from which the ware is manufactured, is found outcropping at several other localities. It is exposed at LaGrange, and attains about the same thickness there as at Ripley, and lies between the two lower coal seams. The bed is about fifteen feet in thickness, but only the upper portion of it is used for pottery. Where it was first opened, the overlying beds had been carried away by Drift agencies, and the surface of the clay shale had been long exposed to the action of atmospheric influ-

ences, which reduced it to the condition of a tough, plastic clay, well adapted to the potters' use. The same effect may be produced on the freshly dug shales, by throwing the material into heaps, and allowing it to remain fully exposed, for a year or two, to the action of the atmosphere. About a dozen potteries have been established in the vicinity of Ripley, and this number may be increased indefinitely as the wants of the community shall require, as the supply of the raw material is abundant.

Fire Clay.—The under-clay of coal No. 2 is often pure enough for the manufacture of fire-brick, though no attempt has been made, so far as I could learn, to test its quality in this county.

Building Stone.—This county is not so well supplied with good building stone as the counties lying south and west of it, where the older rocks outcrop more extensively. The quartzose sandstone, which forms the base of the Coal Measures, may sometimes be safely used for this purpose, and the massive beds of this rock, which outcrop at the base of the bluff, for three or four miles below LaGrange, seem to be sufficiently coherent in their structure to make a durable building stone. The brown magnesian limestone, and the calcareous sandstone, of the St. Louis group, may usually be safely used for this purpose, and the former is especially adapted to the construction of culverts and bridge abutments, where a material is required that will withstand the combined influences of frost and moisture, The sandstone below the upper coal seam, near Mount Sterling, appears to be a very good freestone, and the jail at that place has been built of this rock.

Limestone for Lime.—The best material for the manufacture of common lime is the concretionary limestone, which forms the upper division of the St. Louis group. It is usually a very pure carbonate of lime, and is more extensively used for this purpose than any other limestone in this portion of the State. Along the river bluffs, below LaGrange, this rock has been used at several points for this purpose, though at some localities it contains too much siliceous or argillaceous material to make a pure lime. In the vicinity of Mount Sterling, lime has been made from the nodular gray limestone, which lies between the two upper coals, and it is said to make a strong lime, suitable for mortar and cement, but darker colored than that made from the concretionary limestone of the St. Louis group.

Sand and Clay for Brick.—These materials are so common and abundant in this portion of the State, that it seems scarcely necessary to mention their occurrence at any particular locality; but as it is a primary object, in all reports of this kind, to make known

abroad the natural resources of the State, it seems hardly proper to entirely omit the mention of materials so nearly universal as these in their distribution. There is, perhaps, no mineral product of the State, if we except coal, more important to our vast prairie region than the materials for the manufacture of common bricks, and there are but few branches of manufactures—perhaps none carried on in this State—in which so great an amount of labor and capital is annually employed. The sub-soil clays, at almost any point on the uplands in this county, may be used for brick-making, and where this rests upon the sandy beds of the Loess, the necessary proportion of sand may be obtained on the spot, and at other localities it may be readily found in the bed of some neighboring stream. As the country increases in wealth and population, the desire for more artistic and substantial dwellings will also increase, and with that we shall have a just appreciation of the natural resources so abundantly placed at our command for this purpose.

Soil and Agriculture.—There is probably no portion of this county where the soil is so poor that it will not produce annually fair crops of most of the cereals grown in this latitude, without the stimulant of any fertilizer other than that it naturally contains; but there are some soils more productive than others, and therefore more desirable for the agriculturist. First in rank, we should place the timbered lands of the Loess, characterized by a growth of sugar maple, elm, wild cherry, linden, etc., with the common varieties of oak and hickory. Next, the prairie lands, and lastly, the white oak lands, which occupy mainly the ridges along the breaks of the smaller streams. These last, however, are very good fruit lands, and also produce fair crops of wheat, oats, clover, etc. The principal growth of timber on these lands is black and white oak, and hickory. They have a thin soil, with a heavy clay sub-soil, which will improve under a liberal application of stable manure, applied annually, or by fallowing, and the plowing under of green crops. The prairie region is quite limited in this county, and confined to the northern and western portions. The bottom lands on the Illinois river are very productive, and where they are elevated above the annual overflow of the river, they may be ranked among the most valuable farming lands in the county. The soil is generally a sandy loam, and better adapted to the cultivation of corn than the uplands. The sub-soil is, for the most part, quite sandy, which gives a free surface drainage, where the land is sufficiently elevated above the river level.

Mineral Springs.—The Versailles Mineral Springs, three or four in number, are situated about a mile northeast of the village, in a

little valley surrounded by hills composed entirely of Loess and Drift. The valley in which these springs are situated was originally a part of the ancient valley in which the Illinois river now runs, and was excavated for a hundred feet or more into the Carboniferous rocks that were once continuous across the area now occupied by this valley, and are now found underlying the Quaternary deposits in the adjacent region. The springs, probably, originate in the Loess, or some other Post Tertiary beds, which now form the surrounding hills, and derive the small per cent. of mineral ingredients which the water contains, from these recent formations.

The following analyses of the waters from three of these springs were made in Chicago, the two first by Dr. J. V. Z. BLANEY, and the last by Mr. Geo. A. MARINER, and gave the following results, as the total number of grains of solid mineral matter in an imperial gallon of water:

NUMBER 1.

Sulphate of lime	2.0852
Chloride of sodium	a trace.
Alumina, and a trace of iron	.7268
Bi-carbonate of lime	17.4315
Bi-carbonate of magnesia	12.5750
Bi-carbonate of soda	10.9895
Bi-carbonate of potash	a trace.
Organic matter	a trace.
Silica	.8177
Total solid matter in imperial gallon	44.6257

NUMBER 2.

Bi-carbonate of iron, and a trace of alumina	2.1352
Bi-carbonate of lime	23.2238
Bi-carbonate of magnesia	11.7799
Bi-carbonate of soda	10.9895
Bi-carbonate of potash	a trace.
Silica	1.7036
Chloride of sodium	a trace.
Organic matter	a trace.
Total solid matter in one imperial gallon	49.8320

NUMBER 3.

Carbonate of lime	14.600
Carbonate of magnesia	8.950
Carbonate of iron	.060
Carbonate of soda and potassa	1.320
Chloride of sodium	.003
Sulphate of lime	a trace.
Silica	1.400
Free carbonic acid	11.683
Total grains in one gallon	38.016

CHAPTER XV.

SCHUYLER COUNTY.

This county embraces a superficial area of a little over eleven townships, or about four hundred and fourteen square miles, and is bounded on the north by McDonough and Fulton counties; on the east by Fulton county and the Illinois river; on the south by Brown county; and on the west by the counties of Adams and Hancock. Its surface is considerably diversified with hills and valleys, prairies and heavily timbered woodlands, the proportion of prairie and timber lands being about one of the former to three of the latter. Along the bluffs of Crooked creek and the Illinois river the surface is quite broken and hilly, but even these broken lands possess a rich and productive soil, and are valuable for agricultural purposes, wherever they are sufficiently level for cultivation. The prairies are mostly small, and are restricted to the northern and western portions of the county. The county is well watered, mainly by Crooked creek, and its affluents, which traverse its southern and western portion, and by Sugar creek and the Illinois river, the former intersecting the eastern portion of the county, and the latter forming, in part, its eastern boundary. Crooked creek furnishes considerable water power, and in the early settlement of the country the inhabitants of this, and several of the adjoining counties, were dependent upon the water mills upon this stream for nearly all their milling facilities. More recently, however, steam power has, to a great extent, superseded the old water mill, and most of the mills on this stream now have a steam engine attached, to enable them to run throughout the year.

On the ridges adjacent to the small streams the timber is mostly black oak and hickory, but on the more level portions of the timbered region, as well as on the bluffs of the Illinois river, we find, in addition to these, elm, linden, sugar maple, wild cherry, and honey locust, an arboreal growth which indicates a soil of the best

quality, fully equal to the best prairie soils. Much of the upland, where this growth of timber prevails, is underlaid by the marly sands and clays of the Loess, and rank among the very best lands in the State. Fine blue grass pastures are easily made upon these lands, and the soil is well adapted to the growth of fruit, especially the grape.

On the eastern border of the county there is a belt of alluvial bottoms skirting the Illinois river, from a half mile to about four miles in width. Some portions of this bottom land is above the high-water level of the river, and these lands are very productive, while other portions are subject to annual overflow from the river floods, and are of little value at the present time for agricultural purposes. A considerable portion of this is bottom prairie, but there is usually a belt of heavy timber skirting the river, and also the small streams by which the bottoms are intersected. The timber on these low lands comprise cotton-wood, sycamore, soft maple, ash, elm, hickory, pecan, Spanish oak, swamp white oak, pin oak, black walnut, hackberry, buckeye, honey locust, paw-paw, hornbean, willow, etc. There are also narrow belts of bottom land on some of the larger creeks in this county, as on Crooked creek and Sugar creek, but these seldom exceed a half mile in width, and are covered with a heavy growth of timber, embracing most of the varieties mentioned as occurring in the Illinois river bottoms, with the addition of white walnut, sugar maple, linden, white oak, etc.

The general surface level of the uplands in this county ranges from two to three hundred feet above the level of the Illinois river, and the river bluffs often rise abruptly to the height of two hundred feet or more above the bottoms, but exhibit none of the bold limestone escarpments, so conspicuous on the lower course of the river, where the lower Carboniferous limestones are the prevailing formations.

Geology.

The geological structure of this county, like that of Brown, includes the Quaternary system, the lower portion of the Coal Measures, and the upper divisions of the lower Carboniferous limestones, but differs from that in an additional thickness of the Coal Measures sufficient to bring in another coal seam, No. 5, which is not found in any county south of this, on the west side of the Illinois river. The following section exhibits the formations to be found in this county, in their relative order of superposition and thickness:

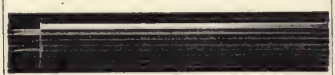
	Feet.
Quaternary, comprising Alluvium, Loess and Drift	100
Coal Measures	2 0 to 250
St. Louis group	30 to 40
Keokuk group	60 to 70

The three lower groups belong properly to what are called stratified rocks, that is, to those that have been formed in regular strata or layers, and also to that division of geological time termed *paleozoic*, because the embedded fossils represent only ancient forms of animal and vegetable life, while the upper division belongs to the most recent geological age, and the fossils which it contains are the remains of species of animals now living, or but recently become extinct. Hence this formation is unconformable with those below it, and may be found immediately overlying either of them, even the lowest, if the others are absent. If the geological series was complete, we should have, above the Coal Measures, and intervening between that formation and the Quaternary, the whole of the Secondary and Tertiary series, embracing many thousand feet in thickness of strata, and representing, in their fossil contents, all the missing links in the great chain of organic life which connect the paleozoic age with the present. But as the Quaternary is the most recent of all the geological systems, it may be found resting directly upon any of the above deposits, from the Tertiary to the most ancient stratified or igneus rocks that outcrop on the surface of the earth. This system includes the alluvial deposits of our river valleys, usually termed Alluvium; the Loess, a deposit of buff-colored marly sands and clays, most conspicuous in the vicinity of the river bluffs, and the Drift, which usually consists of brown or bluish-gray gravelly clays, with water-worn boulders of various sizes, from an inch to several feet in diameter. There is probably no locality in the county where these deposits exceed a hundred feet in thickness, and they attain their greatest development in the vicinity of the river bluffs, where the Loess attains its greatest thickness, and rests upon the Drift clays. In the interior of the county the Loess is generally wanting, and the Drift deposits generally range from thirty to fifty feet in thickness, and consist of unstratified clays, with sand and gravel, enclosing water-worn boulders of granite, sienite, gneiss, prophyry, horn-blende and quartzite, and also the rounded fragments of the limestones and sandstones of the adjacent region. Fragments of copper, lead ore, coal, iron and other minerals are often found in the Drift, or in the gravel beds in the valleys of the small streams, but their occurrence in this position is no indication of the proximity of any valuable deposit of these minerals,

and the fragments which are found in this position are far removed from the beds from which they originally came. Small quantities of gold are reported to have been found in the washed gravel of this formation, but nowhere yet in sufficient quantity to pay the ordinary price of the labor necessary to secure it, and it is quite certain that, in many cases, the material mistaken for gold is either pyrites of iron or yellow mica; the former derived from the Coal Measures or other stratified rocks of the adjacent region, and the latter from the decomposed boulders of sienite or gneiss, transported from the northern shores of the great lakes.

Carboniferous System.

Coal Measures.—This term is applied to the upper division of the Carboniferous system, and it embraces all the coal seams and the associated strata, and when fully developed attains a thickness of eight hundred or a thousand feet in this State. Only about two hundred and fifty feet of the lower position of the Coal Measures are found in this county, which may be illustrated by the following section, showing the general arrangement and comparative thickness of the strata:

10 to 15 feet.	Brown sandy shale.
3 to 6 feet.	Compact gray limestone.
2 to 4 feet.	Bituminous shale, with concretions of limestone.
	Coal seam No. 5.
8 to 10 feet.	Fire clay and septaria.
60 to 80 feet.	Sandstone and shale.
2 to 6 feet.	Bluish-gray arenaceous limestone.
4 to 8 feet.	Bituminous and argillaceous shales.
	Coal seam No. 3.
12 to 15 feet.	Sandy and argillaceous shales.
4 to 6 feet.	Gray limestone.
15 to 30 feet.	Sandy and argillaceous shales.
	Coal seam No. 2.
30 to 40 feet.	Sandstone and shale.
	Coal seam No. 1.
1 to 3 feet.	Fire clay.
15 to 25 feet.	Sandy shale and conglomerate sandstone.

The beds comprising the upper part of the foregoing section are found well exposed in the vicinity of Rushville, and also on a small branch which heads near Pleasant View, and runs eastwardly into Sugar creek. They enclose coal seam No. 5, one of the most persistent and valuable in the Illinois Coal Field, which outcrops in the vicinity of Pleasant View, and from thence trends northwestwardly to Rushville, underlying an elevated plateau around and between these points that forms the water-shed between the tributaries of Crooked creek and Sugar creek. The seam ranges in thickness from four to six feet, and in this county averages about five feet. The roof is generally a bituminous shale, which often contains large nodules of dark-blue or black limestone filled with marine shells, among which are *Productus muricatus*, *Clinopistha lævis*, *Pleurophorus soleniformis*, *P. radiatus*, *Cardiomorpha Missouriensis*, *Discina nitida*, *Schizodus curtus*, etc. Above the black shale there is usually a bed of bluish-gray limestone, containing joints of crinoidea and a few small brachiopods, among which the *Spirifer lineatus* and a small variety of *Athyris subtilita* are the most common. The shale and limestone form an admirable roof to the coal seam, so that it can be worked with perfect safety and in the most economical manner. Below the coal there is usually, first, a thin bed of shaly clay, and then a bed of septaria from two to four feet thick. Messrs. M. Farwell & Co. have been mining this coal in the vicinity of Pleasant View for many years, for the supply of steamboats at Frederick, four miles distant, on the Illinois river. It was first worked by tunneling into the hill where the coal outcrops on the breaks of a small stream running into Sugar creek, but is now worked mainly by shafts sunk from the general surface level down to the coal. I am indebted to Mr. J. Watson Webb, assistant engineer on the Rock Island and St. Louis railroad, for the following elevations:

	Feet.
Height of the coal seam at Pleasant View above the high-water level of 1844	190
Above the river bank, opposite Beardstown	202

This seam has so great an elevation that it will probably be found underlying only the highest lands forming the water-shed already mentioned, and consequently extending over only a limited area in the southern portion of township 2 north, range 1 west, and the eastern portion of township 2 north, range 2 west.

In the vicinity of Rushville, this seam has been worked for many years, and on my first visit to the county, in 1854, I found it opened about a mile northeast of the town, where the seam outcrops in a

small ravine, on the land of Mr. Rose. Subsequently, this coal has been worked at various points in this vicinity, and during the past year a shaft has been sunk about a mile northeast of Rushville, and the coal was found at the depth of twenty-five feet. The coal presents the same general character here as in the vicinity of Pleasant View, and the business of coal mining has been greatly extended since the completion of the Rock Island and St. Louis railroad to this point. The seam has a good slate and limestone roof, and is underlaid by clay shale and septaria, below which there is a thick bed of argillaceous and sandy shales, passing into sandstone. Following down the creek, which runs northwardly from this point into Crooked creek, the strata are found well exposed down to the horizon of coal No. 3, which lies nearly or quite a hundred feet below. At this point, the beds between these coals are more argillaceous than we found them north of Rushville, or in the vicinity of Pleasant View, and showed the following succession of strata downward from coal No. 5:

	Feet.
Fire-clay and shale, with septaria	8 to 10
Clay shale	25 to 30
Sandy shales	30 to 40
Thin-bedded concretionary sandstone	8 to 10
Bluish-gray calcareous sandstone	2 to 3
Clay shale	2 to 3
Black shale	3 to 4
Coal No. 3	2 to 3

The lower coal at this locality is reported to be $2\frac{1}{2}$ feet in thickness, but the opening had been filled up, so that we could not obtain an accurate measurement of it at this point. The calcareous sandstone over this coal contains joints of crinoidea, and the overlying concretionary sandstone contains fragments of plants, among which were many broad ribbon-like leaves of *Cordaites*. Near Oakland Station, on Sugar creek, ten miles northeast of Rushville, No. 3 is found outcropping at several points at the base of the hills. It averages here about three feet in thickness, with a roof of shale and sandstone. The limestone which often intervenes between this seam and No. 2 was seen outcropping below the coal exposed here, but the underlying coal, being below the creek valley, was not seen.

Northeast of Pleasant View a good exposure of all the beds down to the horizon of No. 2 coal may be seen on the small stream running westwardly into Sugar creek, and the following is the order of succession here, below coal No. 5:

	Feet.
Coal No. 5	4 to 5
Clay shale and septaria	8 to 10
Sandstone and shale	116
Hard bluish-gray limestone	8 to 10

	Feet.
Black shale, with concretions of dark-blue limestone	4 to 6
Blue shale, with streaks of coal (No. 3)	2 to 3
Sandy and argillaceous shales	56
Coal (No. 2 coal)	2
Clay shale	3
Coal (No. 2 coal)	2 to 3
Fire-clay and clay shale	20 to 25

By the foregoing section it will be seen that the strata intervening between coals 3 and 5 are mainly sandstones and sandy shales, and the same is true at some other localities, and a portion of this sandstone is a very good freestone, and has been used for the construction of the jail at Rushville, and for foundation walls in the town and in the adjacent regions. This sandstone is well exposed on the breaks of the streams north of Rushville, and affords nearly all the building stone used in this part of the county. Coal No. 3 is not so regular in its development as either No. 5 above it or No. 2 below, and is frequently replaced by bituminous shales. It is worked, however, at several localities in this county, where it ranges from two to four feet in thickness. On Coal creek, about a mile and a half southwest of Frederick, tunnels have been opened in this seam along its line of outcrop, where the coal ranges from two to three feet in thickness, but is hardly equal in quality to that from the seam above. A section on this creek shows all the beds at the base of the Coal Measures, from the horizon of No. 3 coal down to the lower Carboniferous limestone, as follows:

	Feet.
Soft yellow limestone	2
Bituminous shale	2
Coal No. 3	2 to 3
Shale	12 to 15
Hard bluish-gray limestone	4 to 6
Clay shale	15 to 18
Coal No. 2	1½
Blue and green sandy shales	20 to 25
Hard calcareous sandstone	10 to 12
Ferruginous shales	6
Calcareous shale with fossils	3
Blue and gray shale	10 to 12
Shaly sandstone	3 to 4

At this point coal No. 2 is too thin to be worked, and No. 1 is wanting altogether, its place being below the three foot bed of calcareous shale, which contains several of the same species of fossils found in connection with coal No. 1 in Fulton county. At Spillar's mine, a mile and a half above Frederick, No. 3 ranges from 30 to 36 inches in thickness, and the coal appears to be decidedly better in quality than that obtained from the same seam on Coal creek. A half mile below Spillar's the gray limestone of the St. Louis group is seen just above the road at the foot of the bluff, and has

been quarried to supply a lime kiln at this point. The conglomerate sandstone is not represented here, but the ferruginous shale usually found above No. 1 coal is found here, resting directly upon the limestone.

A half mile above Frederick all the beds, from coal No. 3 down to the base of the Coal Measures, are exposed in the face of the bluff, but neither of the coals are thick enough at this point to be worked. The following section was made here, beginning at the top of the bluff:

	Ft.	In.
Sandstone	10	
Buff-colored thin-bedded limestone	4 to 6	6
Shale	12	
Bituminous shale (coal No. 3)	2 to 3	
Shale	42	
Thin coal, No. 2	0	6
Fire-clay and shale	20	
Thin coal, No. 1	0	6
Fire-clay, shale and iron ore		6
Sandstone		6

This is the only locality we met with in the Coal Measures of this county where one or more of these coal seams was not developed of sufficient thickness to be worked, but there may be other points also where the coal is either absent altogether or replaced with bituminous shale.

At the place formerly owned by Mr. James A. Chadsey, in section 32, township 2 north, range 1 east, there are two bands of iron ore in the shale below coal No. 2 that will afford a very good ore for the manufacture of metallic iron. These bands of iron ore occur just above the horizon of No. 1 coal, which is not developed here, and they are respectively 12 and 6 inches in thickness, separated by about two feet of shale. The section at this locality is as follows:

	Ft.	In.
Massive sandstone	30 to 40	
Siliceous limestone	3 to 4	
Bituminous shale, (coal No. 3)	4 to 5	
Shale	27	
Hard gray limestone	6	
Shale	14	
Brash coal (Coal No. 2)	1	
Shale	2	
Coal No. 2	2	
Shale and sandstone	12	
Iron ore	1	
Shale	2	
Iron ore	0	6
Shale, with thin bands of iron ore	6	
Sandstone and streaks of coal, (No. 1)	18	
Hard gray limestone, of the St. Louis group	10	

A little west of Chadsey's place, coal No. 2 has been worked by Mr. John Rebman, where the seam is three feet thick, according to the report of those living near, but the roof had fallen in so that it could not be measured when we were at the locality. It is probable that the parting of shale, which separates this coal in the foregoing section, has thinned out here so that the two divisions form but one seam. On the same branch, a little higher up, the bituminous shale of coal No. 3 is about three feet thick, underlaid by a few inches of impure coal. The shale contains large concretions of dark blue arenaceous limestone, containing fossil shells, among which were *Aviculopecten rectilaterarius*, *Cardiomorpha Missouriensis*, two or three species of small *Goniatites*, *Productus Prattenianus*, and *Chonetes mesoloba*. The hard gray limestone which intervenes between these coal seams at Chadsey's place, and at many other points in this county, was wanting here. It is usually from four to six feet thick, and more or less concretionary in structure, and resembles, in its lithological characters, the concretionary member of the St. Louis group, but may always be distinguished by its fossils, which consist of two or three species of *Naticopsis*, *Spirifer lineatus*, *Pleurotomaria sphærulata*, and *Athyris subtilita*.

The lower division of the Coal Measures, embracing the horizon of three lower coal seams, underlies nearly all the highlands in the central and eastern portions of the county, and are found outcropping on all the principal streams and their tributaries. In the western part of the county, on Crooked creek, and the region lying west of that stream, the beds rise so that the lower Carboniferous limestone and the Conglomerate sandstone form the principal outcrops in the bluffs of the creek, while only a few feet in thickness of the lower portion of the Coal Measures, sometimes including coal No. 2, are found underlying the adjacent highlands. It is not probable that any coal, except No. 2, will be found west of Crooked creek, of sufficient thickness to be of any economical importance.

The upper seam developed in this county, or No. 5 of the general section, is found in the vicinity of Rushville and Pleasant View, and is by far the most valuable coal in the county, and will furnish an abundant supply of coal, sufficient to answer all the demands of the region adjacent to its outcrop for many years. Its position in the series is about one hundred and seventy-five feet above the base of the Coal Measures, and consequently it is only found underlying the most elevated portion of the county, comprising a belt of country from two to four miles in width, extending northwesterly from Pleasant View to a point a few miles northwest of Rushville, where

the surface level gradually slopes away towards Crooked creek, and soon sinks below the level of this coal. No deep mining will be necessary to reach this seam, for if found at all, it will be at a depth varying from fifty to seventy-five feet, or less, below the surface, and it is found outcropping on the head-waters of several of the small streams, that serve to drain the elevated region which it underlies. The seams below this are generally too thin to be worked at the present time, except along their outcrop, where tunnels can be driven into them, and the coal taken out without the expense of sinking a shaft down to the coal, through the overlying strata. Nos. 2 and 3 vary in thickness from two to three feet, while No. 1 was not met with in the county sufficiently developed to be of any economical value.

St. Louis Group.—The outcrop of the lower Carboniferous limestones in this county is restricted to the valleys of the principal streams, and to the Illinois river bluffs between the mouth of Sugar creek and the south line of the county. The St. Louis group, which comprises the upper division of the series, consists of a gray concretionary limestone of variable thickness, ranging from five to twenty feet, forming the upper member of the group, below which we find a brown magnesian limestone, sometimes quite massive, and in regular beds, and, at other localities, intercalated with shales, or passing into a thin-bedded or shaly limestone.

The concretionary limestone is not very regular in its development, but often occurs in isolated patches or outliers, and is a rough gray limestone, presenting no regular lines of bedding, but usually concretionary or brecciated in its structure. It outcrops at intervals along the bluffs of Crooked creek through its whole course in this county, and also along the bluffs of the Illinois river as far north as the vicinity of Browning, where it disappears. It was also found on Sugar creek as far up as McKee's mill, on section 17, township 2 north, range 1 east. The only fossil that was obtained from this limestone was the *Lithostrotion mamillaris*, a siliceous coral that abounds in it almost everywhere, and is found weathered out in the beds of the streams, in masses, often of considerable size, which, from the polygonal form of the single corallites that go to form the mass, are often called *petrified honey comb*. In the vicinity of Birmingham, we found this limestone eighteen feet thick, and overlaid by the Conglomerate sandstone of the Coal Measures. It is underlaid by a bed of calcareous sandstone, and also a magnesian limestone about ten feet thick, which forms the base of the St. Louis group at this locality.

The magnesian limestone is far more regular in its development than the concretionary limestone, and is usually of a rusty brown color on the suface, from the oxidation of the iron which it contains. It contains a few species of fossils, among which are *Productus Altonensis, Archimedes Wortheni, Spirifer Keokuk, Rhynchonella mutata,* and a large *Conularia,* perhaps *C. Missouriensis* of Swallow. This limestone occurs at the base of the bluff at Frederick, and also in the vicinity of Schuyler City, which is the most northerly point where we found it exposed in the river bluffs.

Keokuk Group.—Only the upper portion of this group is exposed in this county, and its greatest development appears to be in the vicinity of Birmingham, in the northwest corner of the county. The greatest thickness exposed here is about fifty feet, of which the lower fifteen feet is a thin-bedded limestone, containing many of the characteristic fossils of this group, above which there is about thirty-five feet of calcareo-argillaceous shales, containing geodes of quartz and chalcedony. The easterly dips of the strata is considerably more than the fall of the creek in that direction, and these beds dip below the bed of the creek, before it strikes the north line of Brown county. The thin-bedded limestones which occur at the base of the section near Birmingham, contain many of the characteristic fossils of this group, among which are *Archimedes Owenana, Productus punctatus, Agaricocrinus Americanus, Platycrinus Saffordi, Spirifer Keokuk,* and *S. neglectus.* The geodiferous shales above contain the common geodes, lined with quartz crystals and mamillary chalcedony, and more rarely, crystals of dolomite, calcspar, and zinc blende. The limestones locally intercalated in the shale contain the same species of fossil that are found in the limestones below.

Economical Geology.

Coal.—The most important and valuable mineral resource of this county consists of the deposits of bituminous coal, which underlie the greater portion of its surface, and especially that portion of the county lying west of Crooked creek. Until quite recently, the coal of this county has had no outlet to market except as it was required for home consumption, but since the completion of the railroad to Rushville, and its probable extension, at an early day, into and through a region further south, which is but poorly supplied with coal, a ready market will be found for all the coal of this county. The upper seam is the most valuable, and, from its greater thickness and excellent roof, can be mined more economically than either

of the lower seams. Its average thickness is nearly five feet, and its product about five million of tons to the square mile. It affords a hard, bright coal, which breaks with a conchoidal fracture, and is traversed by vertical seams of carbonate of lime, which are often stained with the oxide of iron. The following analysis of a specimen of this coal, from the mines near Pleasant View, by Mr. HENRY PRATTEN, former chemist and assistant in the Geological Survey of Illinois, is reported in Norwood's "Abstract of a Report on Illinois Coals," page 24:

Specific gravity	1,286
Loss in coking	40.60
Total weight of coke	59.40
	100.00
Analysis—Moisture	6.00
Volatile matters	34.06
Carbon in coke	52.09
Ashes (deep red)	6.05
	100.00
Carbon in coal	57.08

Another analysis of a specimen from Rose's coal bank, near Rushville, from the same report, is as follows, and is interesting, as showing the variable character of the coals from the same seam at different localities:

Specific gravity	1,303
Loss in coking	41.06
Total weight of coke	58.04
	100.00
Analysis—Moisture	4.05
Volatile matters	37.01
Carbon in coke	46.01
Ashes (white)	12.03
	100.00
Carbon in coal	51.79

The two lower seams, ranging from two to three feet in thickness, are not so extensively worked at the present time as the one above mentioned, but as they underlie a far greater extent of surface than the upper seam, they will, no doubt, furnish by far the greatest amount of coal in the aggregate. No. 3 is worked by Mr. Spiller, about a mile above Frederick, and affords an excellent coal, containing less of the bi-sulphuret of iron than the coal from the upper seam. No. 2 is often divided by a parting of clay shale, and the divisions are then usually too thin to be worked, but at other localities it forms a solid seam from two to three feet thick. One or both of these seams will be found underlying the greater portion of the uplands north and east of Crooked creek, and accessible at

many points in the county, remote from the outcrops of the upper seam, and their value and importance will be eventually appreciated, as population increases, and the demand for coal for mechanical and manufacturing purposes becomes more imperative.

Clays.—Clays suitable for fire brick and for the manufacture of pottery are usually abundant in the lower portion of the Coal Measures, and the bed of clay shale below coal No. 2, which is used for this purpose at Ripley, in Brown county, is also found here. We found an exposure of it on the place formerly owned by Mr. James A. Chadsey, on Sugar Creek, where it presented the same general appearance as at Ripley, and appeared to be equally well adapted to the manufacture of potters' ware. At the coal bank of McKee & Chadsey, on the head-waters of McKee's creek, north of Rushville, there is a bed of excellent fire clay under the upper coal seam, from four to six feet thick. This may be only a local development, however, as at all the other localities in the county where we saw this under-clay exposed, it partook more of the character of a clay shale, and was also rather too thin to be of any economical value. The fire-clay below coal No. 2 is usually of a good quality, and may be profitably worked in connection with the coal, when it is two feet or more in thickness. Wherever a seam of good fire-clay occurs with these lower coals, it will add materially to their value, enabling the miner to drift more economically for both together, than he could do for the coal alone.

Iron Ore.—Iron, either in the form of carbonate or sulphuret, is very generally distributed through the Coal Measures, and the latter is almost always found, more or less, in the coal itself, thereby greatly deteriorating its value. A very good argillaceous iron ore occurs on Sugar creek, on the place formerly owned by Mr. James A. Chadsey, on section 32, township 2 north, range 1 east, intercalated in the shale below No. 2 coal. It occurs in several bands, the thickest one being a foot in thickness, the next in importance about six inches, and then some thinner ones, making altogether an aggregate of about two feet in thickness of iron ore, distributed through some five or six feet of shale. An analysis of this ore by Messrs. Blaney and Mariner, of Chicago, is given in this place, and also, for comparison, the analysis of a similar ore from Pennsylvania:

Analysis of Chadsey's iron ore—

Protoxide of iron	52.31
Lime	1.16
Magnesia	1.48
Silica	8.84
Alumina	10 44
Water and carbonic acid	25.77
	100.00

Analysis of Argillaceous iron ore from Pennsylvania, as determined by Prof. H. D. RODGERS—

Peroxide of iron	.23
Protoxide of iron	53.03
Lime	3.33
Magnesia	1.77
Silica	1.40
Alumina	.63
Water, carbonic acid and bitumen	39.61
	100 00

In regard to the Schuyler county ore, Messrs. BLANEY and MARINER remark as follows: "The Chadsey iron ore is an argillaceous carbonate of iron of excellent quality, comparing favorably with the Pennsylvania ores, the analysis of one of the best of which is given for comparison." There is no question as to the good quality of this ore from Schuyler county, and the only point that remains to be determined is whether it can be found in a sufficient body to justify the erection of an iron furnace in this vicinity. Iron ore of a similar quality is found at about the same horizon at several localities in this and the adjoining counties, but nowhere in large bodies.

Building Stone.—Good building stone is tolerably abundant in this county, and is accessible on nearly all the streams. The sandstones below the main coal seam furnishes a freestone of good quality, which has been used in the construction of the jail at Rushville. The strata vary in thickness from one to three feet, and the rock is even-textured, and is easily cut and dressed, and is used for caps and sills, as well as for foundation walls and all the ordinary purposes for which a building stone is required. It outcrops on McKee's creek north of Rushville, and also on the small branch running east from Pleasant View into Sugar creek.

The brown magnesian limestone of the St. Louis group furnishes the best material for culverts, bridge abutments and similar purposes, where the rock is required to withstand the combined influence of frost and moisture. It outcrops along the bluffs of Crooked creek through its whole extent in this county and also in the bluffs of the Illinois river as far north as Frederick.

The Keokuk limestone, underlying the geodiferous shales of that group, afford some good building stone, but its outcrop is limited

to the bed of Crooked creek, in the northwest part of the county. At the best exposures, which were found in the vicinity of Birmingham, the rock was rather thin-bedded and cherty, but this was on the exposed outcrop of the bed, where the strata had been split into thin layers by the combined influence of frost and moisture. If quarries were opened in this rock, extending back beyond the influence of atmospheric agencies, it would be found to improve in quality. For caps and sills, where a handsome cut-stone is desired, this bed will afford the best material for that purpose that can be found in this county.

Limestone for Lime.—The concretionary gray limestone, which forms the upper division of the St. Louis group, furnishes the best limestone for the manufacture of quicklime to be found in this portion of the State, and it may be found in the bluffs of Crooked creek through nearly its whole course, and at intervals along the bluffs of the Illinois river as far north as Browning.

At Birmingham this limestone is eighteen feet in thickness, which is, however, considerable more than it will average, but it is usually from eight to ten feet, and it will furnish an abundance of limestone to supply the demand of lime in this county for all time to come. A fair article of lime may also be made from the Keokuk limestone, but where the other is accessible it is always to be preferred.

The limestone over the upper coal seam, in the vicinity of Rushville, has also been used for this purpose, but it does not appear to slack readily after burning, and would probably make a dark-colored lime. The abundant supply of both wood and coal in this county will justify the manufacture of lime on as large a scale as the wants of the adjacent region shall demand.

Sand and Clay, for brick making, are abundant in all parts of the county, and may be readily obtained at nearly every locality where the manufacture of common brick is desirable. The brown clay, forming the sub-soil over a large portion of the surface, answers a good purpose for brick making, and sand is abundant in the valleys of the streams and in the eastern portion of the county, in the Loess which caps the river bluffs.

Mineral Springs.—A sample of mineral water was sent to me from this county, the locality of the spring not given, which was sent to Dr. Blaney for analysis, and the following is his report: "Has an acid reaction, a strong styptic taste, a trace of organic matter, and an obscure trace of chlorides. The residue, after evaporation to

dryness, does not give effervescence with acids. A wine gallon (231 cubic inches), by direct determination, gives a residue of 156 $^{28}/_{1000}$ grains of solid matter, which consists of—

Sulphate of lime	73.936
Sulphate of magnesia	2.982
Proto-sulphate of iron	69.959
Silica	1.315
Alkaline sulphate	7.836
	156.028

CHAPTER XVI.

FULTON COUNTY.

This county contains a superficial area of about twenty-four townships, or eight hundred and sixty-four square miles. It is triangular in shape, and is bounded on the north by Knox and Peoria counties, on the east by Peoria county and the Illinois river, on the south by Schuyler county, and on the west by Schuyler, McDonough and Warren counties.

The principal streams in the county are the Illinois river, forming its main boundary on the east and southeast for a distance of about thirty miles; Spoon river and its tributaries, which traverse nearly the whole extent of the county, from north to south, and Copperas creek, which drains a considerable area in the northeastern portion of the county. These streams drain the whole area of the county, and their valleys are from one hundred and fifty to two hundred feet below the general level of the adjacent highlands.

The surface was originally nearly equally divided into prairie and timbered lands, the former occupying the most elevated portions of the county, as well as a part of the Illinois river bottoms, while the timber belts are mainly restricted to the more broken lands skirting the water courses. Much of the original timber, however, has been cleared away in developing the agricultural interests of the county, and splendid farms now occupy a large portion of the area which, but a few years since, was covered with a dense forest. Much of the upland was originally timbered with a dense growth of sugar-maple, black walnut, linden, hackberry, elm, honey-locust and wild-cherry, indicating a very rich and productive soil. This growth of timber usually prevails where the Loess overlies the Drift clays on a tolerably level surface, and these lands, in their productive qualities, are second to none in the State. Where the surface is broken

into sharp ridges, along the borders of the smaller streams, black and white-oak and hickory is the prevailing timber, and the soil is a thin chocolate colored or brown clay loam, well adapted to the growth of small grain, clover or fruit. The prairies in this county generally have a rolling surface, though, in the region about Fairview, there are some quite flat prairies that require draining in wet seasons. The soil on the prairies is a dark-brown or black mould, varying from one to three feet in depth, with a sub-soil of brown clay loam.

The bottom lands, on the western bank of the Illinois river in this county, are from one to four miles in width, and are mostly covered with timber, though there is some bottom prairie near the mouth of Spoon river. A good deal of this bottom land is too low and marshy for cultivation, but where it is sufficiently elevated, the soil is a rich sandy loam, and very productive. The bluffs generally range from one hundred and twenty-five to one hundred and fifty feet in height, and are usually cut into sharp ridges by the valleys of the small stream that drain the adjacent region. The lower part of these bluffs, to the height of seventy-five to one hundred feet, consist of the stratified rocks of the Coal Measures into which the original valley was excavated, and their elevation has been subsequently increased by the accumulation of Drift clays and lacustrine deposits upon them. The valley of Spoon river seldom exceeds a mile in width, and is excavated into the lower Carboniferous limestone on that part of its course extending from Seaville to Bernadotte. The depth of this valley is about the same as that of the Illinois river, but the lower rocks are reached here, in consequence of the easterly dip of the strata, which brings the limestones nearer to the surface in the western portion of the county.

Surface Geology.

The surface deposits of Fulton county consists of Drift clays and gravel, with the subsequent lacustrine and alluvial accumulations. The Drift proper ranges in thickness from thirty to sixty feet, or more, and is usually composed of brown and bluish-colored clays with gravel, and boulders of metamorphic and igneous rocks, varying in size from a pebble to masses of several tons weight. Usually, the brown clays constitute the upper portion of the deposit, and the blue clays the lower. In the vicinity of Utica, a bed of ferruginous Conglomerate, about two feet in thickness, underlies the Drift clays, and similar beds, in local outliers, have been met with in the same

position at several localities in the State. This Conglomerate exactly resembles the bed at Metropolis, in Massac county, on the Ohio river, which has been usually referred to the Tertiary period, and may be of the same age.

On the west side of Big creek bridge, near Canton, in grading the track for the T., P. & W. railroad, a band of black mould or soil containing leaves and fragments of wood, was found below the Drift clays, which is, no doubt, a part of the ancient soil covering the surface anterior to the Drift epoch. A similar bed has been found in sinking shafts and wells in various parts of the State, indicating the prevalence of dry land over a considerable portion of the present area of the State, during the Post Tertiary period. Mr. John Wolf, of Canton, reports a similar bed of black peaty soil, four feet in thickness, underlying the town of Fairview, at the depth of eleven feet. The heaviest deposits of Drift occur along the Illinois river bluffs, and in the vicinity of Lewistown, where the beds range from forty to sixty feet in thickness, while in the central and western portions of the county their general range is from thirty to forty feet.

The Loess caps the bluffs of the Illinois river, and extends back for three or four miles, with a constantly diminishing thickness, towards the interior of the county. This deposit consists of buff or light-brown loamy sand, imperfectly stratified, and locally contains an abundance of land and fresh-water shells, such as now accumulate at the bottom of fresh-water ponds. Its presence in the river bluffs is often indicated by bald, grassy knobs, which prevail more or less wherever this formation is extensively developed. It is always unconformable with the underlying deposits, and presents its greatest thickness immediately at the river bluffs, thinning out rapidly towards the interior of the adjacent region. Where it forms the sub-soil, and is overlaid by a loamy clay soil, we find the heaviest growth of upland timber, such as sugar maple, linden, wild cherry, black walnut and elm, and the lands, when reduced to cultivation, are among the most productive in the State. This is the character of some of the timbered lands in the vicinity of Lewistown, and at some other points in the county adjacent to the river bluffs. When this formation was deposited, the valley of the Illinois, as well as that of most of our large rivers, was a vast fresh-water lake, into which the sandy material that constitutes the greater part of this formation was transported by the action of the rains, and the streams of running water that drained the adjacent highlands. The fossils which it contains are mostly of the same species of land and fresh-

water shells that now inhabit the adjacent region, but occasionally the remains of the Mammoth, Mastodon, Megalonyx and some other extinct mammalia have been found in it in this State.

Older Geological Formations.

The stratified rocks of this county belong, mainly, to the Coal Measures, with a limited exposure of the St. Louis limestone in the valley of Spoon river. Nearly all the uplands in the county are underlaid by coal, and we have found here the most complete exposure of the productive Coal Measures that has been met with in the State, and hence the section constructed in this county will be considered a typical one, and will be used for the co-ordination of the coal strata throughout the central and western portions of the State. We have found here seven consecutive seams, all exposed by their natural outcrop within the county, and all, except the upper one, have been worked to a greater or less extent. The aggregate thickness of these seams is about twenty-five feet, and their individual range is from twenty inches to six feet in thickness. The three lower seams outcrop in the southern and western portions of the county, especially along the bluffs of Spoon river, and as the general dip of the strata is to the eastward, they pass below the level of the Illinois river, and are, therefore, not seen on the eastern borders of the county. The upper seams underlie nearly all the central and eastern portions of the county, and one of them, No. 5, is found south of Spoon river, underlying the highlands in the vicinity of Astoria. The following section, compiled from careful measurements made at the outcrops seen in various portions of the county, will show the relative position of these coals with each other, and the character and thickness of the strata with which they are associated:

Section of the Coal Measures in Fulton county.

4 to 6 feet.	Thin-bedded gray limestone.
15 to 20 feet.	Shales but partly exposed.
	Coal seam No. 7.
37 feet.	Shale and shaly sandstone.
3 to 5 feet.	Argillaceous limestone and bituminous shale.
	Coal seam No. 6.
5 to 10 feet.	Fire-clay and nodular limestone.
15 to 20 feet.	Sandstone and shale.
2 to 3 feet.	Black shale and nodules of limestone.
	Coal seam No. 5.
25 to 30 feet.	Sandy and argillaceous shales.
2 to 6 feet.	Bituminous shale and limestone.
	Coal seam No. 4.
3 to 6 feet.	Clay shale and septaria.
60 to 80 feet.	Sandstones and sandy shales.
2 to 6 feet.	Dark-blue siliceous limestone.
3 to 4 feet.	Black shale.
	Coal seam No. 3.
30 to 40 feet.	Argillaceous and sandy shales and sandstones.
	Coal seam No. 2.
40 to 60 feet.	Sandstone and shale.
3 to 6 feet.	Bituminous limestone and band of iron ore.
1 to 6 feet.	Bituminous shale.
	Coal seam No. 1.
2 to 3 feet.	Clay shale or fire-clay.
20 to 30 feet.	Conglomerate sandstone and shale.

These coals we have numbered from the bottom upward, and they will be described in the same order. The only point in the county where we found No. 1 sufficiently developed to be worked profitably is in the vicinity of Seaville, on the west side of Spoon river, at the crossing of the T., P. and W. railroad. The seam is worked here at two localities, one above the railroad bridge and the other below. At these mines the coal averages about three feet in thickness, and is mined by tunneling into the bluff on the outcrop of the seam. About a hundred yards to the westward of Mr. Harris' mine, below Seaville Station, the seam is divided by a parting of shale, which soon thickens to the westward to three or four feet, and thus destroys the value of the seam for mining. The roof consists of a bituminous shale that ranges in thickness from one to six feet, above which there is a bed of blue argillaceous limestone from three to six feet thick, forming altogether an excellent roof to the coal.

The limestone at this locality has afforded an interesting group of fossils, several of which have hitherto been considered as especially characteristic of the upper coals. We obtained the following species at this locality: *Athyris subtilita, Retzia punctulifera, Spirifer cameratus, S. Kentuckensis, S. opimus, Productus Prattenianus, P. nanus, P. punctatus, Orthis carbonaria, Terebratula bovidens, Schizodus Alpinus, S. amplus, Macrocheilus inhabilis, Eupachycrinus tuberculatus,* or a closely allied species, *Zeacrinus mucrospinus,* and several undetermined species of *Bryozoa.* This group of fossils, if found in connection with a coal the position of which could not be determined from the associated strata, would certainly be considered as strongly indicating an upper coal horizon, and their occurrence here at the very base of the Coal Measures shows that many species, at least of the fauna of the Carboniferous epoch, range through the whole extent of the coal-bearing strata.

We also found this seam well exposed in the cuts of the C., B. and Q. railroad, through the bluffs on the north side of Spoon river, below Lewistown. It is divided here by a parting of shale, which leaves both divisions of the seam too thin to be of any practical value for mining, as the average thickness of the two divisions ranges from six to twelve inches only, and they are too widely separated at this point to be mined together. In the vicinity of Bernadotte a good section of the lower coals may be seen in the bluffs of Spoon river, but the horizon of No. 1 coal was only indicated by a bed of bituminous shale four feet in thickness.

The following section was made near Bernadotte:

	Feet.	In.
Shale and sandstone	38	
Coal No. 2?	2	6
Fire-clay	3	
Arenaceous limestone	1	
Clay shale	4	
Bituminous shale	1	3
Clay shale	7	
Band of septaria	1	
Shale and sandstone	10	
Bituminous shale	1	6
Sandstone and shale	24	
Bituminous shale (coal No. 1?)	4	
Clay shale, with iron ore	5 to 6	
Sandstone and shale	15 to 20	
St. Louis limestone	6	

No. 1 coal is probably represented in the above section by the lower bed of bituminous shale, and we find two additional seams of bituminous shale below the upper coal in this section that are not found at Seaville. Nevertheless, there can be no doubt of the equivalency of the strata at these localities, as at both the sandstone at the base of the section rests directly upon the St. Louis limestone.

In the vicinity of Avon, in the northwest corner of the county, a seam of cannel coal occurs, occupying, apparently, about the same horizon as the lower bed of bituminous shale in the foregoing section, though, from the imperfect exposure of the strata associated with it, its exact position could not accurately be determined. The seam is here only about 14 to 20 inches in thickness, and was extensively worked at the time of our first visit to this county, in 1859, for the distillation of coal oil. Ten retorts were then in operation at this locality, and the product was said to be thirty gallons of oil from a ton of coal. However, the development of the oil wells of Pennsylvania, shortly afterwards, put a stop to the manufacture of oil from cannel coal in this State, and the mines were abandoned. This seam is underlaid here by about five feet of excellent fire-clay, which was worked at that time in connection with the coal, and used in the manufacture of fire brick. About a quarter of a mile from this exposure, on the other side of the hill, a two foot seam of bituminous coal is seen, overlaid by two feet of dark-blue bituminous limestone exactly like that above coal No. 1, at Seaville. The seam of cannel coal is probably the lower division of No. 1, or a local development of another seam, occupying nearly the same horizon.

On Swan creek, one mile north of Avon, the following beds are exposed:

	Feet.	In.
Sandy shales	16	
Coal	0	10
Fire-clay and shale	20	
Band of iron ore	0	10
Bituminous shale	5	
Sandstone	10	

The band of iron ore in the above section resembles very closely that at Chadsey's place, in Schuyler county, and at Seaville in this county, above coal No. 1, and probably occupies the same horizon. If so, it shows a very irregular development of the lower coal in this vicinity, and it is probable that this seam is the least reliable of all the coals in this county except No. 4, hereafter to be mentioned.

Coal No. 2 is one of the most regular seams in the whole series, and usually ranges from two to three feet in thickness. It will be found everywhere in the bluffs of Spoon river, where the strata are well exposed, and its stratigraphical position is generally about forty or fifty feet above the horizon of No. 1, although, in the vicinity of Seaville, the distance intervening between them is about seventy feet. The roof is almost invariably a blue clay shale, and in tunneling it requires to be thoroughly cribbed to prevent the falling of the roof. In the south part of the county, this seam outcrops on Otter creek, about a mile and a half west of Vermont, where it has been worked since the earliest settlement of the county. It ranges in thickness from two and a half to three feet, in this vicinity, and outcrops along the bluffs of the creek for a distance of three or four miles. A boring for oil was made in the valley of this creek, commencing just below the horizon of No. 2, and extending to the depth of about eight hundred feet, but unfortunately no journal was kept of the different strata passed through. The lower Carboniferous limestone was reached at a depth of about sixty feet, as we learned from Mr. Matthewson, who made the boring, and he also stated that no coal was passed through in the boring, which would indicate that there was no development of coal No. 1 at this point.

In the bluffs of Spoon river, south of Lewistown, as well as on some of the small tributaries of that stream in the same vicinity, No. 2 is worked at many points, and about a mile west of the city, at one or two localities examined, the roof was found to be slightly calcareous, and contained several species of fossil shells, among which we observed *Lingula mytiloides, Productus Prattenianus, P.*

muricatus, Macrocheilus, Nautilus, etc. A half mile east of Lewistown this seam has been opened by a shaft forty feet in depth, on the lands of Mr. Hunter. This shaft is situated in the valley of a small stream, and about sixty feet below the level on which the city is built. Two miles and a half southeast of Lewistown, we found a mine opened in this seam, on the lands of Mr. Wm. Winterbottom, on our first visit to the county, in 1859, and at the same time it had been opened a mile nearer to the town, by Mr. Butler. At both these localities the coal varies from two and a half to three feet in thickness, and is overlaid by blue shale and sandstone.

In the vicinity of Bernadotte, this coal is found at an elevation of about eighty feet above the river level, and the coal was mined by Mr. Parks, one mile and a half southwest of the village, in 1859. In the vicinity of Seaville, this seam has been opened on Mr. Harris' place, a little south of the school house, where the coal has been worked in open trenches, by throwing off the overlying shale. In the vicinity of Avon, it was not met with, unless it is represented by the ten-inch seam near the top of the section, on Swan creek. No. 2 usually affords a coal of excellent quality, freer from the bi-sulphuret of iron than the average of Illinois coals, and one that cokes well, and contains more than an average per cent. of fixed carbon. An analysis of this coal will be found further on.

Coal No. 3 has been mined but little in this county, and consequently we know less of its peculiar characters than of the seams lying either above or below it. It is somewhat irregular in its development, resembling No. 1 in that respect. It usually lies from forty to sixty feet above No. 2, but in the bluffs of Spoon river, near Seaville, they are only a little more than twenty feet asunder. It is almost invariably overlaid by black slate, and a dark-blue or bluish-gray siliceous limestone, which contains *Aviculopeeten rectilaterarius, Cardiomorpha Missouriensis,* with two or three species of small *Nautili* and *Goniatites.* About two miles southwest of Bryant station, the limestone and slate above mentioned outcrops at the water's edge on Big creek, and, about a quarter of a mile further down the creek, a tunnel has been made into the wall where it was said to be five feet thick, but, from the partial filling up of the opening, we were unable to ascertain its exact thickness. In the vicinity of Marietta, we found a coal seam opened in 1859, on section 12, township 6 north, range 1 east, which we are inclined to believe is this coal, though the seam is here only about two feet six inches in thickness. In the bluff, at Seaville, the blue siliceous limestone usually overlying this coal is found about twenty-five feet above

coal No. 2, but there is only a few inches of black shale to represent the coal that belongs below it. In the bed of Coal creek, three miles northwest of Fairview, this coal is found in the bed of the creek. It is here only about eighteen inches in thickness, and is overlaid by about two feet of bituminous shale, above which is the blue siliceous limestone about two feet thick, containing the characteristic fossils of this coal. Nodules of septaria, associated with a band of iron ore, occur here, above the limestone. This septaria has a blue ground, veined with pearl spar, and affords very handsome specimens.

Coal No. 5 is a very persistent seam in its development, and has been found at every locality in the county that we have examined, where the proper horizon for it was exposed. On the south side of Spoon river, it underlies the highlands about Astoria, and we found it opened a half mile northwest of the town in 1859. The seam is here from four and a half to five feet in thickness, and is overlaid by two feet or more of black shale, that forms a good roof. Nodules of dark-blue limestone occur in the black shale above the coal, filled with the characteristic fossils of this horizon. On the north side of Spoon river, we found this seam outcropping in the bluffs of Big creek, west of Bryant station, about twenty-five feet above the creek valley. The coal had been undermined here in the excavation of the valley, and a portion of it, with the overlying strata, and covering a considerable area, had fallen down about twenty feet below its original level, and retains its horizontal position so nearly that we were at first disposed to regard it as the apparent outcrop of two distinct seams; but further investigation showed that all the coal exposed here probably belongs to the same horizon. The roof shales at this locality contained many large concretions of bituminous limestone, filled with the characteristic fossils of this seam, among which are *Discina nitida*, very abundant, *Productus muricatus*, abundant, *Clinopistha lævis*, *Schizodus curtus? Pleurophorus soleniformis*, *P. radiatus*, *Nautilus*, one or more species, and a small *Orthoceras*.

This seam has been more extensively worked by Mr. David Williams, at Canton and St. Davids, than by any other person in this county. His main shaft is about half a mile southwest of Canton, and is about eighty-five feet in depth, passing through the following beds:

	Feet.
Drift clay	30
Sandstone and shale	50
Black slate, with limestone nodules	3
Coal No. 5	5

Below the coal there is a bed of septaria limestone, from three to four feet, and below that a fire-clay three or four feet in thickness, passing downward into clay shale. This seam affords a heavy coal, rich in bitumen, and contains from thirty-five to forty per cent. of volatile matters, and from fifty-five to fifty-six per cent. of fixed carbon. At his middle shaft, a little farther down on Big creek, the outcrops of coal No. 6 may be seen about sixty-five feet above No. 5. The coal from the two shafts near Canton finds a market mainly on the line of the T., P. & W. railroad, while that at St. Davids, three miles below, finds a ready market on the Lewistown branch of the the C., B. & Q. railroad, now completed from Rushville to Galesburg.

At Breed's station on the T., P. & W. railroad, about six miles east of Canton, a tunnel has been opened in this seam by Mr. J. R. Breed. The coal averages about five feet in thickness at this mine, and has a good roof of black slate from two and a half to three feet in thickness. The coals Nos. 5 and 6, or 6 and 7, are said to outcrop in the hills in this vicinity, but have not been opened. The upper two feet of the coal at this mine appears to be quite free from iron pyrites, and is reputed a good smith's coal. A band of iron ore, resembling "Black Band Ore," was observed, in connection with this coal, but apparently too thin to be of any practical importance. This seam outcrops at various points on Copperas creek, and may be conveniently worked by tunnels in the hillsides, or in open trenches, where it underlies the creek valleys.

About two miles southeast of Cuba we found this seam opened, in 1859, on the land then owned by Mr. John Winterbottem. The coal at this locality ranges from four and a half to five feet in thickness, and is overlaid by about three feet of black slate, with concretions of argillaceous limestone. This seam affords a coal of good quality, in this vicinity—hard, bright, and generally quite free from iron pyrites. We also saw the outcrop of No. 5, about a mile north of Cuba, where it was found, by measurement, to be thirty-two feet below No. 6. Northwest of Fairview this seam is worked at several points on the breaks of Coal creek, where it presents its usual thickness and appearance. It may be fairly considered as the most valuable of all the coals outcropping in this county, from its wide extent, and the average quality of the coal which it affords.

No. 4 appears to be quite local in its development, and we found it worked only in the vicinity of Cuba, where it ranges from four to five feet in thickness, but it has also been found at two or three

points in the vicinity of Canton, where it occurs in local basins, or "pockets," sometimes attaining a thickness of ten or twelve feet, and then thinning out entirely in a distance of a few rods. It affords a softer and lighter coal than that from No. 5, and, in this respect, it bears some resemblance to the coal from No. 6. A section of the Cuba coal shaft, including the beds below, down to the horizon of No. 4 coal, is as follows:

	Feet.	In.
Hard blue limestone	3 to 4	
Black slate	1 to 2	
Coal No. 6	6	
Fire-clay	5	
Nodular limestone, with *Chætetes milleporaceous*	4	6
Clay shale	6	
Limestone	1	6
Sandstone and shale	5	
Limestone	1	
Black shale	9	
Coal No. 5	4 to 5	
Shale	30	
Black slate	2	
Coal No. 4	5	

In the vicinity of Canton the horizon of this coal is exposed at many points, where no indications of coal is seen. This is the seam worked in the shaft at Cuba, and it affords a tolerably soft coal, that burns freely and leaves but little clinker.

At Mr. Williams' place, five miles and a half northeast of Canton, there are two coal seams exposed in the same hillside, and both are directly overlaid by sandstone. I am inclined to regard them as coals 5 and 6, and they are separated by about thirty feet of sandstone, very similar in its appearance to that usually found overlying No. 5. These coal seams average about four feet and a half in thickness, and the sandstone forms a very good roof. It is possible that one of the coal seams at this locality is only a local intercalation, and that only one of them is represented in the general section, but there were no calcareous beds affording fossils associated with them there, and so the question remains in doubt. Coals No. 5 and 6 are usually overlaid by fossiliferous beds that serve to distinguish them, but no fossils were found in connection with either seam at this locality.

Coal No. 6 is the highest coal in the series that has been worked to any extent in this county, and it affords an excellent coking coal, and also a better smith's coal than is usually obtained from either of the lower seams. On our first visit to this county, in 1859, we found this seam opened at Mr. Piper's place, two miles north of Canton; at Mr. Burton's place, two and a half miles north of Farmington, and it was also worked by Mr. Burbridge at that time, about

three miles west of Farmington, on Little's creek. More recently it has been opened by Mr. Johnson, on lands adjoining Piper's, and about the same distance from Canton. This coal varies in thickness from four to five and a half feet, and at all localities examined in this county the seam is invariably divided, a little below the middle, by a clay parting from one to two inches in thickness. This character alone will serve to distinguish this seam anywhere in this county from either of those below it. This coal is usually overlaid by a hard, black shale, from six inches to two feet in thickness, which comes immediately above the coal, and is succeeded by buff or yellow shaly or compact limestone, above which comes a heavy bed of sandstone. At some localities the slate and limestone are wanting, and the sandstone rests directly upon the coal. Where the limestone is present, it contains a great number of minute fossils, resembling grains of wheat, and about the same size. This small fossil is called *Fusulina*, of which there are two or three species in the Coal Measures of this State, and they may be regarded as the characteristic fossils of this coal. It is also frequently underlaid by a calcareous fire-clay, containing a fossil coral in great abundance, known as *Chætetes milleporaceous*, which, so far as we know, has not been found in this State below the horizon of this coal, but has also been found in connection with No. 7. There is also a thin layer of limestone above No. 6 coal, that appears to be mainly composed of the remains of minute *Foraminifera*, and polished sections of the stone exhibit many of these microscopic fossils in an excellent state of preservation.

Six miles northeast of Canton, on a branch of Copperas creek, near Mr. Rosenbaum's place, this coal has been worked by tunneling into the base of the hill, on the outcrop of the seam, and the strata intervening between this and the upper seam are well exposed. The distance between these coals at this point is thirty-seven feet, and the intervening strata consist entirely of sandy and argillaceous shales.

These two coals are also found together at Powell's coal bank about about two miles east of Norris, where No. 6 has been mined for several years to supply the coal demand of the surrounding region.

Burbridge & Co.'s shaft, one mile west of Farmington, in the valley of one of the branches of Coal creek, reaches coal No. 6 at a depth of twenty-six feet. The coal is four feet and a half in thickness at this shaft, and similar in quality to that at Piper's mine, near Canton, This seam lies about ninety feet below the level of

the town of Farmington, and coal No. 7 outcrops on the hillside east of Burbridge's shaft, and from thirty-five to forty feet above No. 6. Two miles northeast of Fairview No. 6 is mined in the bluffs of Coal creek, and is here about four feet and a half in thickness, with a good roof of black slate, above which there is about twenty feet of massive sandstone. This seam probably underlies some three or four townships, north and east of Canton, and may be reached anywhere in that region at a depth varying from twenty-five to one hundred feet.

Coal No. 7 is the highest coal strata seen in the county, and being usually only from sixteen to twenty inches in thickness no attempt has been made to mine it in competition with the thicker seams that underlie it and outcrop over a much wider area in this county. Judging only from the appearance of the coal, where it was exposed in natural outcrops, we were disposed to regard it as a coal of a very superior quality, good enough apparently to be used in the iron furnace without coking, and hence if it should be found as much as two feet in thickness at some favorable locality, it might be mined as successfully as some of the heavier seams are at the present time. It outcrops on the head of Big creek, about a mile north of Piper's mine, along most of the hillsides east of Norris to Copperas creek, and also underlies all the highlands about Farmington. At Powell's mine, two miles east of Norrris, the following measured section was made, showing the relative position of the two upper coals, and the character of the strata associated with them, and they constitute the highest beds of the Coal Measures seen in this county:

	Feet.	In.
Compact, hard gray limestone	4 to	6
Shale, partially hidden	15	
Coal No. 7	1	4
Shale and shaly sandstone	35	
Brown argillaceous limestone	2	6
Bituminous shale	1 to	2
Coal No. 6	4	6

The limestone at the top of this section appears to form the bed rock over the highest ground in the region of Farmington, where it is immediately overlaid by the Drift deposits, and is probably the highest rock exposed south and west of the Kickapoo. Just over the line, in Peoria county, the bed is twenty feet or more in thickness, which was probably its original thickness in the vicinity of Farmington, but it has been reduced to its present thickness perhaps by erosion anterior to or during the Drift period.

Conglomerate.—At the base of the Coal Measures in this county there is from ten to twenty-five feet of coarse-grained sandstone, which probably represents the Conglomerate usually underlying the lower coals. This sandstone was only seen at two or three points in the bluffs of Spoon river, between Seaville and Bernadotte. Just below Seaville station it measures about twenty-five feet in thickness, extending from the under clay of No. 1, which rests immediately upon it, down to the low-water level of the river, where it rests upon the St. Louis limestone. The sandstone is here a massive, coarse-grained rock, quite ferruginous, and forms a mural cliff, from its tendency to harden on exposure. At Bernadotte it is thin-bedded and partly shaly, and crumbles readily on exposure to the atmosphere. It is quite irregular in its development and general aspect, and cannot always be identified unless found in connection with the coal seams above or the limestone below, because of its close resemblance to some other sandstones of the Coal Measures.

St. Louis Limestone.—The outcrop of this formation appears to be restricted to the valley of Spoon river, between Bernadotte and Seaville, and there are but few points where it is well exposed. At Bernadotte there is only from six to ten feet of this limestone exposed above the lower-water level of the river. The rock is concretionary in structure, and contains *Lithostrotion proliferum* and *L. mamillaris*, the most characteristic fossils of the upper division of this formation. Just above the mouth of Barker's run, on Spoon river, the following section of this limestone group was seen:

	Feet
Gray concretionary limestone	10
Brown magnesian limestone	12
Arenaceous beds, partly hidden	16

The two lower divisions of the above section are tolerably even-bedded, the layers varying in thickness from six inches to two feet, and will afford an excellent building stone. The magnesian limestone is especially valuable for culverts and bridge abutments, where a rock is required to resist the combined influence of frost and moisture. A very fine specimen of *Lithostrotion mamillaris* was found at this locality, by Mr. James H. Cooper, and presented by him to the State Cabinet. We saw no other locality in the county where so great a thickness of this formation was exposed as at this point.

Economical Geology.

Bituminous Coal.—The great mineral wealth of this county, as must be apparent from the perusal of the preceding pages, consists in its almost inexhaustible beds of coal, which are so distributed as to be easily accessible to every portion of the county. The three lower seams, ranging from two to four feet in thickness, outcrop in all the principal streams in the southern and western portions of the county, while coals 5 and 6, the thickest and most valuable seams known in the northern portion of the State, underlie the central and northwestern portions of this county, and are easily accessible at any point where a large supply of coal may be required. These coals underlie nearly, or quite, seven townships in this county, with an aggregate thickness of about fourteen feet, and throwing out of the calculation entirely No. 4, which is more local in its development than the other two, we still have an aggregate of from nine to ten feet of coal, equal to 9,000,000 tons of coal to the square mile, as the product of these two seams from the central and northwestern portions of the county alone, and within one hundred and fifty feet of the surface, at the general level of the prairie region. Coal mining is yet in its infancy in this most highly-favored region, and until the construction of the two railroads which now intersect the county the demand for coal was too limited to justify any large expenditures in coal-mining operations. Now an extensive market is opened on the Mississippi river for the coals of this region, and the cities of Burlington and Keokuk in Iowa, and Warsaw in this State will soon obtain their main supplies of coal from this county.

In quality, the coals to be obtained here are fully equal to the average of our Illinois coals, and they will answer all the purposes for which coal is required, except for the smelting of iron in the raw state, and it is probable that a part of No. 6 and the whole of No. 7, if it could be found thick enough to be worked successfully, could be used in the iron furnace without coking. No. 6 is generally a soft coal, with a tendency to break into cubic blocks, and has afforded the following result, on analysis by Messrs. BLANEY and MARINER, of Chicago:

Water	6.17
Ash	1.91
Bitumen	29.82
Carbon	62.10
	100.00
Coke	64.10

The specimens affording the above, which is about the average of two analyses, was taken from Mr. Piper's mine, two miles north of Canton.

An analysis of specimens from John Winterbottom's mine, two miles southeast of Cuba, probably No. 4 coal, gave the following as the average result of two analyses:

Water	5.18
Ash	7.51
Bitumen	30.06
Carbon	57.25
	100.00
Coke	64.76

An analysis of No. 6, from Effnour's mine, near Cuba, gave, as the average of two analyses, the following:

Water	5.94
Ash	5.38
Bitumen	30.80
Carbon	57.85
	99 97
Coke	63.23

These analyses of the two most important coals in the county will serve to indicate the average quality of the coals of this region, and also show the variations that may occur in the quality of the coal from the same seam at different localities, as evidenced by the result of the analyses of specimens of No. 6 from Effnour's mine, near Cuba, and from Piper's mine, near Canton. At the former locality the coal contains a much larger per cent. of ash, with more bitumen and less carbon, than at the latter, and in quality it seems to be considerably below the average of the coal from this seam at other localities in the county.

The following analysis of coal No. 2, from Colchester, in McDonough county, is given here to indicate its general character in this portion of the State. It is taken from Norwood's "Abstract of a Report on Illinois Coals," and was made by the late Mr. Henry Pratten, former assistant in the Illinois Geological Survey:

Specific gravity	1.290
Loss in coking	41.2
Total weight of coke	58.8
	100.0
ANALYSIS.	
Moisture	5.4
Volatile matters	35.8
Carbon in coke	56.8
Ashes (white)	2.0
	100.0
Carbon in coal	60.10

Coal No. 4 is rather local in its development, and was only identified in the shafts at Cuba, and at Mr. John Winterbottom's mine, two miles and a half southeast of that town.

The lower seams are generally much thinner than those above, and usually range from two to four feet in thickness, but afford a very good coal, especially No. 2, which, in its average quality, is probably not surpassed by any coal in the State. Nevertheless, occurring here in close proximity with seams much thicker and more favorably situated for working extensively, it will only be mined along the outcrop of the seam, for the supply of the immediate neighborhood, until the thicker beds overlying it are partially exhausted. It is but seldom that No. 1 is found thick enough to be mined profitably, and the mines at Seaville are the only ones that we met with in this seam in the county. No. 3 has been opened at several points, but the mines have been subsequently abandoned, probably because it could not be successfully worked in competition with No. 4, which usually outcrops in the same vicinity.

Cannel Coal.—A thin seam of cannel coal occurs in the vicinity of Avon, in the northwest corner of the county, and before the discovery of the vast deposits of oil in Pennsylvania, was mined for the distillation of oil. We first visited the locality in 1859, and found ten retorts in operation at that time, the product of which was said to be from three to five hundred gallons of oil per day. The seam from which the material was supplied was only from fourteen to twenty inches in thickness, and the cost of mining at that time was about two dollars per ton. It was said to yield about thirty gallons of oil per ton, but the subsequent discovery of oil in Pennsylvania and Ohio put a stop to its manufacture from cannel coal in this region.

Fire Clay.—A good bed of fire-clay, from three to five fieet in thickness, occurs below the cannel coal at Avon, and was worked by the Avon Coal Company, in connection with the coal, and they were thus enabled to manufacture the fire-brick required for their own furnaces. At Andrews' coal bank, two miles and a half north of Marietta, there is from two to three feet of good fire-clay below the coal, and at many other localities in the county, especially in connection with the lower coals, clays suitable for pottery or fire-brick may be obtained.

Iron Ore.—Iron ore, in considerable quantities, was met with at several localities in the county. In the vicinity of Seaville there is

a bed of limonite from eight to twelve inches thick immediately above the limestone that forms the roof of the lower coal. This ore closely resembles that at Chadsey's place, in Schuyler county, an analysis of which is given in the report on that county, in the preceding chapter, and it holds about the same stratigraphical position. The same band of ore was seen in the vicinity of Avon, and it probably extends over a large area in the county. In the vicinity of Utica there is a considerable amount of impure carbonate of iron, occurring in regular layers of nodules, or kidney-shaped concretions, disseminated in bands through a bed of clay shale, from fifteen to twenty feet in thickness. The bands of ore are from two to three inches thick, and are separated by from two inches to a foot in thickness of shale, and the aggregate thickness of this ore at this locality would be from three to four feet, and it would probably yield from thirty-five to forty per cent of iron. The shale in which this ore is embedded is probably the shale over coal No. 3, and if so, an abundant supply of coal could be obtained on the spot, either from that seam or No. 2, which lies from forty to fifty feet below it. The roof shales of coals Nos. 4 and 5 abound in large ferruginous concretions, but they are generally too strongly charged with pyrites to be of any value for the iron furnace. Iron ore is almost universally disseminated through the Coal Measures in this State, but usually in too small quantities to be of any great value for the production of metallic iron, but it is quite probable that the ores of this county may at some future time become valuable for this purpose.

Building Stone.—The Coal Measures seldom afford large bodies of limestone of sufficient thickness, and of the right quality for good building stone, and this material has to be mainly supplied from the sandstones, which are usually the prevailing rock in the coal regions. There are some beds of limestone, however, in this county that furnish a suitable material for rough walls, though the supply is quite limited. The limestone that immediately overlies coal No. 6, in the vicinity of Cuba and Canton, as well as at several other points in the county, affords some good building stone; and the Farmington limestone, which overlies coal No. 7, also affords some tolerably good rock, in rather thin layers, that has been used very generally in the vicinity of its outcrop, and answers very well for foundation walls, etc. The gray concretionary limestone of the St. Louis group, which is found in the bed of Spoon river below Seaville, and at Bernadotte, is not regularly stratified, and therefore not a good building stone; but on Barker's run, near where it

empties into Spoon river, there is about twelve feet of brown magnesian limestone in regular beds, underneath the gray beds of this group, that will afford the most durable stone to be found in the county.

Sandstones are abundant and easily accessible to most parts of the county, and when carefully selected they answer a good purpose for foundation walls, and for various other purposes. In the vicinity of Seaville the sandstone both above and below coal No. 1 is found in heavy beds, and seems to be sufficiently coherent to form a durable building material. The stone for the bridge abutments and culverts on the T., P. and W. railroad, in this vicinity, has been taken from these beds, and although sufficient time has not yet elapsed to fully test its durability, it seems to be a reliable stone for building purposes. In the vicinity of Lewistown there is a sandstone intervening between coals Nos. 2 and 3 which is a good freestone, and has been extensively quarried and used as a building stone in the city and vicinity. It is not altogether uniform in its texture, however, and requires to be carefully selected where it is to be used in the construction of permanent buildings. In the vicinity of Canton a very good bed of sandstone is found below coal No. 6, and further north there is also a heavy bed of the same kind of rock overlying this coal, which was seen at the mines on Coal creek, two miles and a half to three miles northeast of Fairview, and at some other points. Most of these sandstones are more or less ferruginous, the iron, in the form of a brown oxide, being disseminated in minute grains through the entire substance of the rock, giving it a tendency to harden on exposure to the atmospheric influences, thereby improving its quality and durability as a building material.

Limestone for Lime.—The gray concretionary beds of the St. Louis group, which outcrops in the valley of Spoon river from Seaville to Bernadotte, will afford the best material for the manufacture of quicklime to be found in the county. This rock is usually a nearly pure carbonote of lime, and the beds in the vicinity of Alton, which also belong to this group, afford the purest and whitest lime made in the State. The gray beds, which are the only ones adapted to this purpose, are only from eight to ten feet in thickness in this county, and form the upper portion of the group, on which the Conglomerate sandstone of the Coal Measures rests.

The limestone over No. 6 coal may also be used for the manufacture of quicklime, but at some localities it is too argillaceous, and when burned does not slack readily, and might make a good

hydraulic cement, to which it seems best adapted. The limestone above No. 7 coal is generally a purer carbonate of lime than any other of the Coal Measure limestones in this county, and might be extensively used in the vicinity of Farmington for lime burning.

Sand and Clay for Brick.—These materials are abundant on all the uplands in the county. On the bluff lands adjacent to the Illinois river the Loess affords an excellent material for this purpose, in which the ingredients are often mixed in just the right proportions. The sub-soil of the prairies and of the oak ridges furnish an abundance of brown clay, which, mingled with sand that is abundant in the beds of the streams, forms a good material for this purpose. These materials are so universally distributed that they may be readily found in every neighborhood, and on almost every farm in the county.

Soil and Agriculture.—There is considerable variety in the soils of this county, though there are none so poor that they will not produce good crops annually of most of the cereals usually grown in this region, when judiciously cultivated. The most productive soils are those covering the prairie lands, and those underlaid by the Loess in the vicinity of the river bluffs. The latter were originally covered with a heavy growth of timber, consisting of sugar maple, black and white walnut, linden, elm, hackbery, wild cherry, honey locust, black and white oak, and two or three varieties of hickory. This is the character of the best lands in the vicinity of Lewistown, and over a considerable area along the eastern borders of the county. They produce quite as heavy crops of corn, wheat, oats, barley and grass as the best prairie soil, and are much better adapted to the growth of fruit, especially grapes and apples. The peach seems to grow equally well on the prairie, though it is doubtful whether the trees would live as long or produce as freely as on the timbered lands. The prairie lands are very productive, and have a deep chocolate-brown or black loamy soil, rich in organic matter, and when sufficiently rolling produce annually large crops of corn and grass. Wheat is a far more uncertain crop on the prairie soil than on lands originally covered with timber. The poorest lands in the county are the white oak ridges that skirt the borders of the small streams. These lands have a thin soil, with a stiff clay sub-soil, but will produce fair crops of wheat, oats and clover, and are also equal, if not superior, to the prairie lands for the growth of fruit. They require a more generous treatment, and are greatly benefited by occasional fallowing, and plowing under green crops.

For the following complete list of the trees and shrubs indigenous to this county, I am indebted to Mr. JOHN WOLF, of Canton, whose quiet and unobtrusive labors in botany, geology and conchology have resulted in important additions to our knowledge in these departments of Natural History. The State collection is also indebted to him for a fine series of the fossils of the Coal Measures in this vicinity, and I am also under personal obligations to him for much valuable information in regard to the most important localities to be visited in this county. To Mr. DAVID WILLIAMS and family, of Canton, I am personally indebted for the generous hospitality extended to me while engaged in the survey of this county, and for valuable information and assistance in the prosecution of the field work of the survey. I am also under obligations to Mr. HARRIS, near Seaville, for hospitable entertainment while at work in that vicinity, and to the citizens generally for acts of personal kindness and assurances of interest in the general results of the work in which I was engaged.

LIST OF THE TREES AND SHRUBS FOUND IN FULTON COUNTY.

Acer dasycarpum, Ehr. Sugar maple.
A. sacharinum, Wang. White or silver maple.
Æsculus glabra Willd. Buckeye.
Amelanchier Canadensis, T. & G. Service berry.
Amorpha fruticosa L. False indigo.
Ampelopsis quinquifolia, Mich. Virginia creeper.
Betula nigra L. Red birch.
Carpinus Americanus, Mich. American hornbeam.
Carya alba, Nutt. Shell-bark hickory.
C. amara, Nutt. Swamp hickory.
C. olivæformis, Nutt. Pecan nut.
C. tomentosa, Nutt. Mocker nut.
C. sulcata, Nutt. Thick shell-bark.
Ceanothus Americanus, L. New Jersey tea.
Celastrus scandens, L. Bitter-sweet.
Celtis occidentalis, L. Hackberry.
Cephalanthus occidentalis, L. Button bush.
Cercis Canadensis, L. Red bud.
Cornus alternifolia, L. Alternate leaved cornel.
C. paniculata, L'Her. Panicled cornel.
C. sericea, L. Silky cornel.
C. asperifolia, Mich. Rough leaved dogwood.

Corylus Americanus, Walt. Hazel nut.
Cratægus coccinea, L. Red thorn.
C. crus-gallii, L. Cock spur thorn
C. tomentosa, L. Black thorn.
var. a. C. mollis. T. and Gray.
" *b. C. flabellata. Boæ.*
" *c. C. pyrifolia, Ait.*
" *d. C. punctata. Jacq.*
Diospyros Virginianus, L. Persimmon.
Euonymus Americanus, Jacq. Waahoo.
Fraxinus Americanus, L. White ash.
F. viridis, Mich. Green ash.
F. pubescens, Lam. Red ash.
F. quadrangulatus, Mich. Blue ash.
F. sambucifolius, Lam. Black ash.
Gleditschia triacanthus, L. Honey locust.
Gymnocladus Canadensis, Lam. Coffee nut.
Hydrangea arborescens, L. Wild hydrangea.
Juglaus nigra, L. Black walnut.
J. cinerea, L. White walnut or butternut.
Juniperus Virginiana, L. Red cedar.
Lonicera parvifolia, Lam. Small honey-suckle.
Morus rubra, L. Red mulberry.
Negundo aceroides, Mœnch. Box elder.
Ostrya Virginica, Willd. American horn-beam.
Platanus occidentalis, L. Sycamore.
Populus tremuloides, Mich. American aspen.
P. grandidentata, Mich. Large toothed aspen.
P. monilifera, Ait. Cottonwood.
Prunus Americanus, Marsh. Wild plum.
P. Virginiana, L. Choke cherry.
P. scrotina, Ehr. Wild black cherry.
Ptelea trifoliata, L. Hop tree.
Pyrus caronaria, L. Crab apple.
Quercus alba, L. White oak.
Q. Leana, Nutt. Lea's oak.
Q. coccinea, Wang. Scarlet oak.
Q. castaria, Willd. Chestnut oak.
Q. imbricaria, Mich. Laurel oak.
Q. rubra, L. Red oak.
Q. palustris, Du Roi. Pin oak.
Q. bicolor, Willd. Swamp white oak.

Q. macrocarpa, Mich., and var. *oliræformis, Mich.* Burr oak.
Rhamnus lanceolatus, Pursh. Buck thorn.
Rhus glabra, L. Smooth sumac.
R. aromatica, Ait. Fragrant sumac.
R. radicans, L. Poison ivy.
Ribes floridium, L. Wild black currant.
R. rotundifolium, Mich. Wild gooseberry.
Rosa setigera, Mich. Prairie rose.
R. lucida, Ehr. Dwarf wild rose.
Rubus villosus, Ait. Blackberry.
R. occidentalis, L. Black raspberry.
Sambucus Canadensis, L. Common elder.
Sassafras officinalis, Nees. Sassafras.
Similax rotundifolia, L. Green brier.
Staphylea trifolia, L. American bladder nut.
Salix tristis, Ait. Dwarf gray willow.
S. humilis, Marshall. Black willow.
S. nigra, Marshall. Black willow.
S. longifolia, Muhl. Long leaved willow.
S. cordata, Muhl. Heart leaved willow.
S. angustata, Pursh. Narrow leaved willow.
S. criocephala, Mich. Silky headed willow.
Tillia Americana, L. Basswood or linden.
Ulmus Americonus, L. American elm.
U. fulra, Mich. Slippery or red elm.
Viburnum Lentago. L. Sheep berry.
Zanthoxylum Americanum, Mill. Northern prickly ash.

CHAPTER XVII.

DeKALB, KANE AND DuPAGE COUNTIES.

These three counties, the description of which is included in the present chapter, are situated contiguously to each other, in the northeastern portion of the State, and, together, comprise a rather irregularly shaped area of about fifteen hundred square miles. Their respective boundaries and areas are as follows:

DeKalb county is bounded on the north by Boone and McHenry counties, on the east by Kane and Kendall counties, on the south by LaSalle county, and on the west by Lee and Ogle counties. It comprises an area of eighteen townships, or about six hundred and forty square miles. The remaining boundaries of Kane county are, McHenry county on the north, Cook and DuPage counties on the east, and Kendall county on the south. Of DuPage, Cook county on the north and east, and Will county on the south. The areas of these two counties are, respectively, about five hundred and twenty-eight and three hundred and thirty square miles.

The principal water-courses in this territory are, first, the Fox river, which traverses the whole length of Kane county, near its eastern border; the Kishwaukee, or Sycamore river, which, rising in the western part of Kane, runs through the northern portion of DeKalb county, and the DuPage, which, with its two forks, drains nearly the whole of DuPage county. These, with their tributaries, and a few minor streams, furnish an abundant supply of water in all parts of this district. Springs are not generally numerous, excepting in the immediate vicinity of the water-courses.

The predominating character of the surface of the country in this district is that of an upland, rolling prairie, with, however, numerous groves, or timber islands, and extensive wooded tracts along the principal streams. The proportion of wooded land to prairie may perhaps be as small as one to three or four, but the checking

of the prairie fires which formerly swept over this region, and the greater attention which has of late years been given to arboriculture, have probably made up for the deficit caused by the cutting down of the timber for fuel and other purposes, and it may perhaps be safely said that the amount of surface actually occupied by growing woods, excepting in a few localities in the immediate vicinity of the railroads, is not less at the present time than in the period of the early settlement of this region. The principal kinds of timber are, black, white, red and burr oaks, bitternut and shell-bark hickory, black walnut, butternut, elm, black and white ash, soft maple, sugar maple and cottonwood. The red cedar and arbor vitæ are also found in a few localities in this district. The varieties of the soil are altogether the same as have been described in the reports on the adjoining counties—on the prairie, a deep-black or dark-brown humus, and in the timber, a lighter colored sandy clay soil or loam. In a few localities the sandy or gravelly character of the soil is more predominant, as in township 42, ranges 6 and 7, in the northern part of Kane county, where some of the ridges or irregular elevations of the land, separating small, wet prairies or sloughs, are quite sandy. These low prairies are found, of inconsiderable area, in various portions of the district, but are more abundant in this particular region. Along some of the principal streams, and especially the Fox river, in Kane county, the country is more roughly broken, and can in some parts even be called hilly, although the more abrupt elevations seldom exceed eighty or one hundred feet above their immediate base.

The geological formations, other than the surface deposits of Alluvium, Drift, etc., which appear at the surface in this district, comprise portions of the Niagara, Cincinnati and Trenton groups. The St. Peters sandstone, also, judging from facts developed in the survey of LaSalle county, probably underlies a portion of the southern part of DeKalb county, but as the whole of that region is covered with heavy accumulations of Drift, no exposures of this formation are to be found. The exposures of the older rocks are found only along the courses of the larger streams, and at one or two isolated localities in DuPage county, on the easternmost borders of the district. Elsewhere they are overlaid with heavy deposits of Drift, varying from twenty to eighty or one hundred feet in thickness, and in some localities even more.

Above the Drift proper we have only the surface soils and a few local alluvial deposits in the river bottoms, etc. Some of the springs along the upper course of the Fox river, in Kane county, issuing

from the lower limestone bed of the Niagara group, hold much lime in solution, and deposit calcareous tufa. A considerable deposit of this material occurs on the eastern bank of the river, about three miles north of the city of Elgin, and close to the track of the Fox River Valley Railroad. This deposit was formerly quarried for the manufacture of lime, and is exposed in the excavations to the depth of about four feet. It appears to be regularly bedded, and varies in structure from a loosely compacted, porous material, resembling petrified moss, and full of traces of vegetable remains, to a compact *travertin*, almost resembling in density some of the older rocks. The whole extent of this deposit is not to be seen, as it is covered by from one to four feet of soil bearing large forest trees. It is exposed, however, for a distance of several rods in the ditches alongside of the railroad track.

The remains of extinct Post Tertiary mammals have been found in the superficial deposits in one or two localities in this district. A portion of the remains of a Mastodon, consisting of the tusks and several teeth, were obtained in excavating for the track of the Chicago, Burlington and Quincy railroad, near the city of Aurora, and are now preserved in the museum of Clark Seminary, at that place. The skull, and it is said the other parts of the skeleton, also of *Casteroides Ohioensis*, were found by a farmer in a slough not far from the town of Naperville, DuPage county. The skull was obtained by Col. Wood's museum, in Chicago, where, I believe, it still remains.

The deposits of Drift in this district consist of loam and blue clays and hard-pan, with here and there, amid the mass, seams and pockets of sand and gravel. Boulders of granite, quartzite, greenstone and various other rocks are abundant in various localities on the surface of the ground, and are frequently met with in excavations for wells, etc., and large deposits of rolled boulders, chiefly of limestone from the underlying Niagara beds, similar to those already described in the report on Cook county, occur in the Drift deposits of the adjoining portions of Kane and DuPage counties. These may be well observed in the vicinity of Elgin, and in DuPage county, near Danby and Bloomingdale. Sections of the bluffs in various places along Fox river show that the materials of the Drift have been re-arranged, and present a stratified appearance. The limestone boulder deposits may, perhaps, be referred to this modified Drift.

Pieces of wood, and occasionally large trunks and branches of trees, have been found at considerable intervals in the Drift, and

such cases are reported in various parts of this district. At Sycamore, in DeKalb county, large pieces of wood were said to have been met with in the blue clays of this formation, at the depth of fifty feet, in digging a well, and other instances were mentioned, though no particulars were given.

It is not easy to estimate the thickness of these deposits, in all parts of this district, as it is very seldom penetrated by wells or any artificial excavations; nor is there generally in any such works, any record kept of the materials, which would also be very desirable in the study of this formation. The bluffs along Fox river, however, furnish partial data for a portion of the district, and, judging by these, the Drift will average from fifty to one hundred feet in thickness above the uppermost bed of rock. Away from the river, on either side, the thickness is most probably not less, and may be even more. At Sycamore, a well is said to have reached, by digging and boring, a depth of — feet, without penetrating the blue clays and hard-pan of this formation.

The artesian well bored by the Chicago, Burlington and Quincy railroad company, at their work-shops, in the city of Aurora, affords a means of ascertaining the thickness of the older geological formations at that point. In this boring, after passing through thirty or more feet of the alluvial surface deposits of the river valley, the section afforded is as follows:

	Feet.
1. Alternating beds of grayish-white and gray limestone, sixty-eight feet, followed by forty feet of buff or brown limestone, *Niagara group*	108
2. Sixty-four feet of light grayish limestone, underlaid by one hundred and one feet of shale and shaly beds, the middle portion dark colored and bituminous, *Cincinnati group*	165
3. Gray, buff, and nearly white limestone, *Galena and Trenton*	232
4. Buff and reddish-yellow sandstones, St. Peters	158

A comparison between the record of this boring and the Chicago section, given in the report on Cook county, will show a very considerable diminution in the thickness of the different formations above the St. Peters sandstone. In the Chicago section, the total vertical thickness of all the strata between the base of the Niagara and the top of the St. Peters sandstone, is six hundred and thirty feet, which is here decreased to three hundred and ninety-seven feet, a very noticeable difference. As, however, none of the beds below the upper portion of the Galena limestone are represented in the surface exposures within the limits of this district, the remainder of this section only is of general interest.

Niagara Group.—This formation underlies the whole eastern portion of the district, including the whole of DuPage county, and the

greater part, if not all of Kane county. Its western border cannot be located with any certainty. It seems quite probable, indeed, that it extends westward through the central portion of DeKalb county, but, from the want of outcrops, this point cannot be determined.

The lower part of this group, which alone is exposed in this district, consists of gray, buff, and sometimes nearly white, limestones, in some cases dolomitic in composition, and in others nearly pure, and affording a good material for the manufacture of quicklime. The beds also contain much chert, unequally distributed throughout the strata, in thin seams and lenticular masses. A large portion of the rock, however, is quite free from this material, and answers excellently well as a building stone. Its aggregate thickness in this district cannot be easily ascertained. In Kane county, the section before given probably includes all the beds exposed, but to the eastward the outcrops are not so easily identified with it. At the utmost, however, it will probably not exceed one hundred and fifty feet, if, indeed, it approaches that thickness. The principal outcrops are as follows:

In the eastern portion of DuPage county, on the northwestern quarter of section 2, township 39, range 11, about half a mile west of the railway station at Cottage Hill, a light-gray or nearly white sub-crystalline limestone is quarried. The rock is concretionary in its structure, showing bedding very imperfectly, and though very full of traces of organisms, affords but very few well preserved fossils. The whole depth of the quarry is fifteen or twenty feet, but at the time of my visit only about ten feet of the upper portion was exposed, the bottom of the quarry being filled with water. Directly east of this point, in the village of Cottage Hill, rock is said to have been struck in a well at a depth of twelve feet. The rock exposed in this quarry is not seen in any of the other outcrops in this district so as to be identified by its lithological characters. It seems possible, indeed, that this may be the uppermost bed of the Niagara group within these limits.

Passing to the southward about three miles, we find the nearest outcrop occurring on the western bank of Salt creek, in the southwestern quarter of section 14, on the land of Mr. Torode. About nine feet in thickness of thin-bedded limestone is here exposed, the upper two or three feet porous and yellow, the remainder a rather even-textured stone, light-drab or gray in color, and containing numerous nodules of chert. The beds appear to increase in thickness the deeper the rock is worked. There is in this quarry a

slight, in some places almost imperceptible, local dip to the northward. The upper portion of the rock exposed at this place, is fossiliferous, affording various corals, crinoids, bryozoa, and brachiopoda, but generally ill preserved, and often indistinguishable as to species.

Further to the southward, no exposures are met with, until the vicinity of the DesPlaines river is reached, where we find the bottom land, opposite Lemont, underlaid by limestone beds. The rock also appears to a limited extent, near the base of the bluffs, on the northwestern edge of the river bottom, but no good exposures are met with on this side of the river. On the flats, it is generally covered with a thin layer of surface soil, and wherever it does appear at the surface, is so changed by weathering as to make an almost complete alteration in its appearance. It seems probable, however, the beds at a sufficient depth under the surface may afford a good building material.

To the northwestward of this the only remaining outcrops of rock in DuPage county are met with on the western fork of the DuPage river, at Naperville and below. At Naperville, in the quarries on the southwestern bank of the creek just below the mill-dam, there is a section consisting at the base of an even-textured, regularly-bedded light-drab or buff limestone, about six feet of which is exposed in the excavation. Nodules of chert, of irregular flattened forms, are quite frequent in the upper part of this bed, but less abundant below, where the layers also appear to be thicker and more adapted for a building stone. This bed is overlaid by about nine feet, in vertical thickness, of a thin-bedded, yellowish or dark buff limestone, showing a light-gray color on freshly-fractured surfaces, and closely resembling the upper portion of the rock at Torode's quarry on Salt creek. The upper beds in these quarries afforded specimens of *Atrypa reticularis*, *Strophomena rhomboidalis*, *Orthis flabellum*, *Leptæna transversalis*, *Spirifer radiata*, *S. Niagarensis*, *Orthoceras undulatum*, *Calymene Blumenbachii*, and species of *Illænus* and *Sphærexochus*, together with many corals and bryozoa. The lower beds were altogether less abundant in individuals; the species were mainly the same. In many cases the fossils were merely casts, but some were nearly perfect.

Going from Naperville in a southeasterly direction along the western bank of the creek, we find at a distance from the town of a mile or a mile and a half, limestone, apparently the same as the upper beds at Naperville, occurring in the bottom of ditches and small runs, and alongside of the road. Still farther on, at Kimball's

mill, a thickness of eight or nine feet, probably of the lower bed, is shown at the western end of the mill-dam, on the right bank of the stream. On the opposite bank, about two hundred yards above the dam, on the southeastern quarter of section 19, township 38, range 8, the upper beds are well exposed and have been quarried. Here they yield in abundance the same species of fossils as at Naperville, and in the same condition. Below Kimball's mill the lower beds of buff limestone appear along the western bank of the creek for a short distance, and have been quarried at one or two points. It disappears entirely, however, under the Drift before reaching the county line.

In Kane county all the exposures of rock, with one exception only, are along Fox river. Along this line of outcrop the greatest development of the formation is at Aurora and Batavia and between these two points. Both above and below this particular portion of the river a lesser thickness of the formation is exposed. Commencing at the southern limit of the county and going up the river, the following are the principal exposures met with:

At the village of Montgomery, and almost exactly on the southern line of the county, there is an exposure of about eight or nine feet of thin-bedded buff limestone, abounding in thin seams and flattened nodules of chert, which appears much broken up and decomposed on the exposed surfaces. No good specimens of fossils were obtained at this point, and only a few unrecognizable fragments were observed. On the opposite side of the river, at the eastern extremity of the mill-dam, rock was again observed, similar in lithological character to that at the first mentioned outcrop, only that it was harder, less decomposed and more free from chert. A slight dip, one or two degrees, to the northeast or a little more north, was observed at these exposures, which would apparently bring the one last described above the other. The whole thickness, however, including both exposures, and such intermediate beds as may be concealed by the surface deposits, cannot well exceed twenty-five or thirty feet.

Continuing up stream, no outcrop or exposures of rock in place are met with until entering the city of Aurora. Here, in the southern part of the city, on the eastern bank of the river, at Hoyt's quarry, about forty feet of the limestone is exposed. Of this the upper nineteen or twenty feet is a rather thin-bedded buff limestone, with chert very abundant in layers and lenticular nodules. The remainder of the excavation below this is in a regularly-bedded impure limestone, varying in color from light-gray to buff or drab,

and closely resembling in appearance portions of the well known Joliet stone. The dip in this quarry is to the northeast, and amounts to from one to four degrees. The line of separation between the upper and lower beds is quite distinct in this section. In the upper beds a few indistinct fossils were observed: *Atrypa reticularis* and *Orthoceras undulatum*, were the only species recognized. The lower portion of the quarry, on the other hand, appeared to be entirely destitute of fossils, but abounded in small geodes, containing crystallized quartz.

In the northern part of the city the limestone again appears on the western bank of the river, at first only at the edge of the water, but gradually appearing higher on the bank further up the stream. It also underlies the surface farther up the bluffs, but how high cannot be exactly ascertained, as it is mostly covered with soil. Nearly a mile above the city there are several quarries on the side of the bluffs on the western bank of the river, which show vertical cliffs of limestone from fifteen to twenty-five or thirty feet or higher. The stone in these quarries is an impure limestone, in some layers approaching a true dolomite in composition, of a decidedly buff or yellow color. Some of the beds in some localities are deeply stained with oxide of iron, and present a dark, reddish-brown color. There was here, apparently, a slight local dip to the northward, which, however, was not very noticeable. There may be, possibly, a slight undulation of the strata, or anticlinal, having a strike about northwest and southeast, but at all events, it is very inconsiderable, and does not affect the general disposition of the strata in this region. I have considered the rock exposed in these quarries and along the river bank as below the cherty beds of Hoyt's quarry, and, perhaps, the equivalent of the strata immediately below them, though not exactly agreeing in lithological characters. I have, however, no positive proof of this. But few fossils are to be found at these localities; the only specimens obtained were two or three imperfect *Calymene Blumenbachii*, and the pygidium of an *Illænus*.

To the north of these quarries, along the western bank of the river, and, though to a somewhat less extent, on the eastern bank also, ledges of rock are seen almost continuously near the water's edge, for some seven miles, as far as the town of Batavia. In most cases only a very limited thickness of the weathered edges of the strata are to be seen; at none of the intermediate points is there to be seen a good section, where either of the beds observed in the southern exposure at Aurora can be recognized. The strata generally lie nearly level, though there are in some places appearances

of local dipping, which may, perhaps, be sometimes due to the undermining and consequent tumbling of large masses of the rock. About two miles and a half north of Aurora a cherty band may be traced in the rock for a short distance, and then disappears. It or another similar one again appears at the base of the bluff near the mouth of Mill creek, about a mile and a half below Batavia. For nearly half a mile the limestone appears on the banks of the creek also. It is here a brittle, yellow limestone, thin-bedded, and quite fossiliferous in places. One of the best exposures of this rock is on Mr. Stevens' place, at the old mill-dam, a few rods above the crossing of the wagon-road from Aurora to Batavia. Here some layers are almost entirely made up of casts of *Pentamerus oblongus*, with very rarely a coral or other fossils. Between this point and Batavia, although the ledges still continue along the base of the bluffs, there is but one exposure of more than a very few feet; a disused quarry, about a mile south of the latter place, which shows a perpendicular cliff of about twenty or twenty-five feet, all apparently of one bed of yellow or buff limestone. No fossils were afforded by this locality.

At Batavia, in the quarries on both sides of the river, the beds are precisely similar to and probably identical with those worked at Hoyt's quarry in Aurora. In Mr. Barker's quarry, on the western side of the river, there is about twenty-five feet of buff and drab limestone, overlaid by eight feet of the upper cherty layers; the line of division between the two is very distinct. This upper cherty portion of the rock appears in the exposure to be much shattered, but is consolidated again by a stalagmitic cement. It is altogether worthless as a quarry rock, and is very troublesome to remove. Throughout the greater part of the quarry the strata lie horizontally, but at its northern end there is a sudden dip to the southward of from ten to fifteen degrees, bringing the lower beds to the level of the top of the quarry. On the opposite side of the river the same dip is to be seen in Shannon's quarry exactly where the strike would lead us to look for it. In the three principal quarries on the eastern side of the river, those of Messrs. Starkey, Shannon and Randall, respectively, the same lower beds are shown as at the one already mentioned on the western bank, but at Shannon's quarries, only, are the upper cherty beds exposed. Near the bottom of this quarry there is also a thin stratum of bluish shaly limestone, and a seam, two or three inches thick, of sandstone, which is probably only local. A very noticeable feature in all these quarries is the presence of large, well defined, perpendicular joints, trending about

E. S. E. and W. N. W. Another set of joints, at right angles to these, is less conspicuous. In Shannon's quarry, two of these joints, parallel to each other, enclose about ten feet in horizontal thickness of the strata, which is said to be shaly and entirely worthless for building purposes, while on either side are continuous strata of valuable stone. Fossils appeared to be exceedingly rare in these beds, and when found, except in a silicified condition, are very indistinct.

Just north of the bridge, on the western side of the river, at Batavia, is a quarry, the rock of which is a light-yellow limestone, very similar to that at Mill creek, and containing in one of its narrow layers great numbers of *Pentamerus oblongus*. The whole exposure is of about twelve feet. I considered this exposure, and that at Mill creek, as of a lower bed than those exposed in the six principal quarries at Batavia, which cannot be identified as appearing any more above the surface to the northward of that point.

From Batavia northward, the ledges may still be observed along the river bank. The rock is probably that of the lower beds; the upper ones may still perhaps be in place higher up in the bluffs, but if so, they are completely covered with soil, and invisible. Before reaching Geneva, however, the ledges disappear and are not again met with until that place is reached. On the eastern side of the river, a little north of the bridge, a quarry affords a section of about eleven feet, the upper five of which are of a yellowish limestone, similar to that already mentioned as occurring at Batavia and Mill creek. Under this, six feet of a white grayish stone is exposed, which is quarried for building stone. The upper bed affords a few *Pentamerus oblongus*, the lower one appears almost destitute of fossils. A lower bed of similar limestone, exposed on the river bank a little higher up, afforded a few corals and other fossils.

North of Geneva, the limestone may be observed outcropping at various points, and forming the bed of the river and several smaller streams. The best section which is afforded by any exposure between this point and St. Charles, may be seen at a place called Cedar Bluffs, about a mile south of the latter place. The two lower beds seem similar to those which are exposed farther down the river, at Geneva:

	Feet
1. A thin-bedded buff and gray limestone, apparently destitute of fossils	7
2. A bluish or bluish-white shaly bed	1
3. Brittle yellow limestone, similar to the upper bed at Geneva, and containing many *Pentamerus oblongus*, corals, etc	4
4. Bluish or grayish-white rock, containing a few fossils, *Illænus*, *Orthoceras*, etc., and resembling in appearance the lower bed at Geneva, exposed	3

Below the lowermost bed in this section, and the level of the river, is a considerable thickness of strata, which are not exposed well enough to enable us to judge of their lithological character. Much of it, however, is in all probability the same as No. 4. A half a mile farther north, at McAulay's quarry, the same beds are again seen, but, in this exposure, No. 1 is somewhat thinner, and No. 4 thicker by five feet. Here, it also is divided into two strata, each four feet thick, not differing lithogically, but with a very distinct line of separation. At this place, I obtained from bed No. 4, in addition to the species collected at the other locality, *Calymene Blumenbachii*, *Pentamerus oblongus*, a *Cornulites*, and some additional corals. The quarry in the village of St. Charles, on the western side of the river, may perhaps be in another bed than those exposed here, as the stone seems slightly different; it, however, resembles No. 1, rather than the others, and is possibly identical with that bed.

At St. Charles, the rock disappears under the surface, and no exposures are met with, up the river, for nearly four miles. At this distance from the village, however, a slight undulation of the strata, or a low anticlinal, brings it again to the surface, and it is prominent, in perpendicular ledges and cliffs of low elevation, for nearly a mile along the western bank of the river, and for a less distance on the eastern side. The exposures of the rocks of this group here consists of about twenty-five feet of the lowermost beds, resting immediately on the shales and shaly limestones of the Cincinnati group. The slope here is very slight each way, and indeed, but for the fact of the underlying beds of the Cincinnati group being brought to the surface, the disturbance of the strata would be hardly noticeable. The rock consists of intercalated beds of light-gray limestone and buff colored dolomite, containing in the lower portion a few thin seams of chert. The light-gray portions of the rock answer well for burning into quicklime, and some of the other beds seem to be suitable for the manufacture of cement. The axis of the disturbance is crossed by the road at Mr. Jucket's lime-kiln, in the southwest corner of section 3, township 40, range 8 east, and its trend is about northwest and southeast. The Fox river is diverted from its course by this obstruction, and runs in a northwesterly direction along its northeasterly edge for about a mile, breaking through it and running again to the southward, in the southwestern part of section 3, township 40, range 8. But few fossils were obtained in the bed of the Niagara group at this locality, only *Stromatopora concentrica*, a *Favosites*, and *Illænus*, together with a few imperfect casts of gasteropod shells, and some indeterminate corals being found.

North of this disturbance, exposures are also wanting along the river till the village of Clintonville, distant between two and three miles, is reached, where the rocks once more come to the surface. In the quarry here, on the western side of the river, a little above the village, in the southwest quarter of section 26, township 41, range 8, the same strata and order of superposition are observed as at Cedar Bluffs, below St. Charles, with the exception of the upper part of No. 1, only about ten feet of which is exposed. The thin shaly seam, No 2, is also much thinner, having here a thickness of not more than five inches, and about three feet in thickness, immediately below, represent No. 3. The remaining eight feet exposed, to the bottom of the quarry, represent No. 4. The whole thickness exposed is fourteen feet and five inches. The fossils are similar in species to those collected at the former locality, *Pentamerus oblongus*, *Halysites catenularia*, and various indeterminate casts of corals and shells. There is, at this locality, a very slight dip to the eastward, not more than one or two degrees. North of this point there are no exposures of the older rocks along the river within the limits of the county.

The only exposures of the Niagara group which remain to be mentioned as occurring within this district are met with in the forks of Big Rock creek, in the southern portion of section 26, township 38, range 6, in the southwestern portion of Kane county. There are here two principal outcrops, one on each branch of the stream, and not more than a quarter of a mile apart. The bottom land lying between the two is also underlaid at a depth of from two to four feet by the same rock, which has here been also artificially exposed at a point about midway between them. At the eastermost exposure the rock is a soft ferruginous limestone of a yellow and, in some specimens, a reddish color. At the diggings on the western fork, and in the bottom land, it seems less ferruginous and more compact and hard, and generally better fitted for use as a building and flagging stone. As nearly as could be made out, the strata were horizontal. The limestones here are hardly fossiliferous; such few specimens as were obtained, however, were identical with those found near the base of the formation elsewhere. On the creek below this point no exposures are met with north of Kendall county line, though the rock is evidently not far beneath the surface.

Cincinnati Group.—The rocks of this group underlie a small area in the northern part of DeKalb county. As, however, they are exposed at only two or three points within this area, it cannot be defined with any exactness; it may, however, be approximately

described as a narrow strip, extending into this county from the north or northeast, and having a width from east to west of probably not more than eight or ten miles. Its western border is probably somewhere near the west line of range 4 of townships east of the third principal meridian. South of the Kishwaukee, or Sycamore river, there are no outcrops in DeKalb county; its limits, therefore, cannot be well defined in that region, though it probably does not extend very far to the southward.

One of the few exposures of this group in the DeKalb county area occurs on the north bank of the Kishwaukee, just north of Stewartsville, where about fifteen feet of interstratified green and blue shales and rotten limestone, with some more solid beds, were seen. The exposure continues only so far as the beds have been worked. Elsewhere the high banks of the creek presents only grass-grown slopes. No dip was observed in this locality, nor were any fossils discovered, except a few fragments of Trilobites generally undistinguishable as to species on account of the incoherency and fragility of the material. The more solid beds were not rich in fossil remains; the only specimens found were fragments of *Calymene senaria* and *Lingula*. A little over two miles from this point, near the middle of the dividing line between sections 17 and 18, or a little over into section 17, is another quarry into a yellowish, and in some parts reddish, porous limestone, almost entirely made up of undistinguishable organic remains, and containing also some well preserved fossils. The depth of the excavation was about five feet, with apparently no change in the character of the rock. About a quarter of a mile further south I observed another similar excavation in similar beds of limestone.

Mention has been made, in the remarks on the Niagara group, of an isolated exposure of Cincinnati beds forming the base of a low anticlinal, cut through by Fox river, in the western part of section 3, township 40, range 8. No good section is afforded at this place, as a sloping, grass-grown talus extends almost uninterruptedly from the foot of the ledges of Niagara limestone to the level strip of bottom land along the river. The highest point to which this formation extends in the axis of disturbance is about thirty feet above the river. The upper beds here appear to be shaly, containing many thin plates of a highly fossiliferous gray limestone, containing many of the characteristic fossils of this group. These are washed out abundantly in the small runs and water channels in the bank, and afford in great numbers *Orthis subquadrata*, *Orthis biforata*, *O. testu-*

dinaria, O. occidentalis, Strophomena alternata, Leptæna sericea, and many other common species.

Trenton Group.—The upper beds of the Galena limestone, which alone are included in the surface outcrops of this district, underlie the surface in that portion of DeKalb county lying west of the area already mentioned as occupied by the Cincinnati group. The exposures are few and, with one exception, confined to the banks of the Kishwaukee and its immediate vicinity. The principal exposures are as follows:

Near the center of the western half of section 30, township 42, range 3, and about a quarter of a mile from the western line of the county, I observed, in a small ravine at the side of the road, a ledge of thinly-bedded, buff-colored, porous, fossiliferous limestone, which had been quarried to some extent, and was exposed in the natural and artificial section to a depth of about ten feet. No dip was perceptible in this exposure. The fossils were, from the nature of the rock, very imperfect, being principally very indistinct internal casts of *Murchisonia, Pleurotomaria,* etc. Similar beds of limestone are said to occur in the bed of the Kishwaukee, in the northern parts of sections 21 and 22, but at the time of my visit the water was too high to make any thorough examination.

Passing up the creek we find again, in the southeast quarter of section 42, similar ledges of brownish-yellow and buff-colored limestone appearing to the height of about six feet on the north bank of the creek. Fossils were numerous at this place also, but were similar in condition to those in the locality previously described. One and a half miles farther east, in the western part of section 2, township 42, range 4, is another exposure, at which also the rock has been somewhat quarried. The limestone is worked right at the water's edge, and is said to appear also in the bed of the stream in this vicinity. The upper beds here are friable and thin; the lower beds, however, are said to answer well as building material for the rougher kinds of work.

Economical Geology.

Building Stone.—The best stone for general building purposes which is found in this district, is that which is obtained from the quarries at Batavia and the southern part of the city of Aurora. This is apparently near the top of the Niagara group, as it is developed along the Fox river, though probably within one hundred eet from the base, and actually in the lower part of the formation.

It is probably in about the same geological horizon as the well known Joliet stone, which it very much resembles. It is here a light-gray or drab evenly-bedded limestone, the beds varying from eight inches or less to nearly three feet in thickness, affording blocks of all sizes required for building purposes. The stone dresses well, is strong and durable, and after being cut is of an agreeable light-drab or buff color, which, however, is liable to be considerably deepened by the action of the weather. Occasionally, also, some ayers of the stone contain nodules of pyrites which, decomposing, leave unsightly stains on the walls and buildings in which it is used, as may be observed, for instance, in the court house at Geneva. This stone is used extensively for building purposes, not only in this district, but also in other parts of the State. The quarries at Batavia are worked in the side of the river bluffs, and the consequent necessity of removing the superincumbent masses of drift and surface soil is a hindrance to their extension, causing a great increase in the labor and the expense of working them.

The other exposures of the Niagara group, and the limestones of the Trenton and Cincinnati groups, occurring in various parts of this district, also afford a supply of material suitable for foundations, rough walls, etc., and are also used to some extent for general building purposes. The rock, however, is generally too thinly and irregularly bedded to afford a superior quality of building stone. Large portions of this district, however, are entirely destitute of a local supply of building stone, and in some parts this material, whenever it is required, must be transported a distance of from ten to eighteen miles.

Limestone for Lime.—Many of the limestone beds of the Niagara group, in this district, afford a good material for the manufacture of lime, and have been worked for this purpose. Lime kilns have been established at Naperville and other places in DuPage county, and at several points along the Fox river, in the vicinity of the towns of Aurora, Batavia, Geneva and St. Charles, in Kane county. In northern DeKalb county, the outcropping beds of the Galena limestone have been used for the same purpose, and are reported to have furnished a good article. The deposit of calcareous tufa, three miles north of the city of Elgin, and its former manufacture into lime, have been already mentioned in the earlier part of this chapter.

In the lowest part of the Niagara group, at Fayetteville, on the Fox river, about four miles north of St. Charles, there occurs a stratum of somewhat argillaceous magnesian limestone or dolomite, which,

it is reported, has been tried and found to answer for the manufacture of hydraulic cement. An analysis of this rock, by Dr. BLANEY, may be found in the appendix to the third volume of the original Reports. Beyond this, I am not aware of any material which has been tested for this purpose, within the limits of this district.

Other Building Materials.—Clay and loam suitable for the manufacture of brick may be obtained from the drift and surface deposits in various parts of this district. The best material for this purpose, however, is found in the northern part of Kane county, at the village of Dundee. The clay here, which appears to belong to the Drift formation, is quite free from oxides of iron, and burns into brick of a delicate pale-yellow color, in assorted lots, not inferior in appearance to the celebrated Milwaukee brick. In other places, however, the same difficulty is met with as in Cook county; the clay contains too great a proportion of lime to produce at once a handsome and durable article of brick. Sand and gravel for mortar and concrete are sufficiently abundant in all parts of the county.

The limestone boulders and hardheads, which are so abundant in various places along the Fox river, in Kane county, are also used to a limited extent as a building material, in ornamenting the fronts of houses, etc.

Peat.—Deposits of this material, of greater or less extent, are found in various parts of this district, but are most numerous and extensive in the northern portion of Kane county, where there are some rather extensive level, wet prairies. But little attention, however, has as yet been paid to the economical value of this material, and the depth and extent of the deposits have been scarcely tested. At the village of Carpenterville, on the Fox river, one mile north of Dundee, there is a deposit of peat one hundred acres or more in extent, and averaging at least four or five feet in depth, which has been somewhat used in the neighborhood as fuel, and found to answer well. Still more extensive beds occur farther west, in the towns of Rutland and Hampshire, which are reported to have also been used to a slight extent.

Agriculture, etc.—The principal varieties of soil, etc., in this district, were briefly mentioned in the beginning of the present chapter. The prairie soil, which covers the greater portion of the surface, does not differ from the average in this part of the State. It is always productive, and yields good crops by proper tillage. Although a few comparatively poor sections may be found, yet, as a whole, in the elements of material prosperity, it is not behind any other

territory of equal extent in this part of Illinois. The nearness and the easy accessibility of most parts, by means of the several railroads, to the great commercial metropolis of the northwest, adds greatly to its other advantages.

Water is readily obtained by sinking wells to depths varying from ten to fifty feet, and very rarely more. The supply here comes largely from water veins in the gravel beds or seams, which traverse the clays or hard-pans of the Drift. It is only in extraordinarily dry seasons that any inconvenience is felt in the want of a sufficient supply of water for stock.

CHAPTER XVIII.

McHENRY AND LAKE COUNTIES.

These two counties are situated contiguously to each other, in the northeast corner of the State, and are bounded, respectively, as follows: McHenry county is bounded on the north by the State of Wisconsin, on the east by Lake county, on the south by Cook, Kane and DeKalb counties, and on the west by Boone county. Lake county, lying to the east of McHenry, has for its remaining boundaries, on the north, east and south, respectively, the State of Wisconsin, Lake Michigan and Cook county. The superficial area of the whole district is about ten hundred and six square miles, of which area the greater portion, six hundred and twelve square miles, is within the limits of McHenry county, and the remainder, three hundred and ninety-four square miles, in Lake county.

The principal streams by which this region is watered are, in the order of their importance, as follows: The Fox river, which, entering this district from the north, and passing through several expansions or lakes, traverses it in a general north and south direction; the DesPlaines, also rising in the State of Wisconsin, and pursuing a generally parallel course; the Kishwaukee, rising in the central and western portions of McHenry county, in two or three branches, and flowing westward into Boone county; and the Nippersink, a tributary of the Fox, also rising in McHenry county, and traversing several of its northern townships. Besides these streams and their lesser tributaries, there are one or two small water-courses discharging directly into Lake Michigan, and a slough, or succession of sloughs, in the southeast corner of Lake county, are drained by the northern branch of the Chicago river, which, in this county, can hardly be called a stream, except during the wet seasons. That portion of the district, however, which drains its waters into the lake, and may

properly be said to belong to the basin of the St. Lawrence, is very inconsiderable, a mere strip along the coast, hardly averaging three or four miles in width.

The surface configuration of this district is somewhat varied, embracing not only the upland rolling prairie and woodland, the prevailing character of the surface in this part of the State, but also extensive wet prairies or sloughs, in certain localities, and tracts of alternate sand ridge and marsh of the most recent lucustrine formation. This last character of the surface, however, is confined to a narrow strip extending along the coast from Waukegan northward, and in its widest part not more than two miles across. The ridges here are composed almost entirely of sand, but, nevertheless, support a growth of stunted black and red oak, dwarf juniper, and occasionally white pine; their elevation is but a very few feet above the lake. The outermost one is the widest, and indeed, in many places, the only one, being constantly enlarged by accretions along its lake front, and by the loose sand blowing inland from the beach, which is itself a wide one, and is fronted by shallow water for some little distance from the shore. The low prairie or marsh, between the ridges and the bluffs, is overflowed in many portions during a great part of the year, and in some places is scarcely ever passable. In the firmer spots there are occasionally clumps or thickets of bushes and low trees, but over the greater portion the only vegetation is rank grass and rushes. A strip of land of this general character extends along the coast nearly to the State line, gradually rising, however, to the northward, and becoming dryer and more wooded.

This low coast does not extend south of Waukegan, and the bluffs, which, north of that place, are a mile or more inland from the immediate coast to the southward, in many places without even a strip of beach between their bases and the water's edge. Being thus exposed, the bank crumbles rapidly under the wearing influence of the waves of the lake, and, in violent storms, large masses are often undermined and carried away. Another frequent cause of landslides is the water percolating the clay from the top of the bank downwards, which, when the frost is coming out of the ground, or after long continued wet seasons, must affect materially the rapidity of the process of degradation. The height of the bluffs, however, some seventy or eighty feet, is such as to render the inward progress of the lake upon the land comparatively slow. The actual rate of wear could not be exactly ascertained, but from the appearance of the clay bluffs themselves, I judged that in the course of years it might

be considerable, amounting, perhaps, to several hundred feet in a century.

Inland from the bluffs we find for several miles a gently undulating surface, which, for the most part, was originally covered with a heavy growth of timber, principally of the different species of oak and hickory, with a sprinkling of other kinds of trees. The soil is a light colored, somewhat arenaceous clay or loam, with more or less admixture, in its upper portion, of organic matter, rendering certain portions slightly darker in color than the remainder. The same general character of the soil prevails in the undulating timbered tracks in all parts of the district, and also forms the subsoil of most of the prairie. It appears to me to be a somewhat modified upper member of the Drift, and may be seen with the same general characteristics in similar situations in all of the northeastern counties of the State.

Passing still further westward in Lake county, the general appearance of the country is found to be the same, undulating prairie and forest, with here and there over the surface small level prairies and lakes or ponds. These latter are most numerous in the western and northwestern portions of the county, where they are extremely abundant and vary in extent from a few acres to several square miles. The largest are those on the upper course of the Fox river, near the McHenry county line, Pistakee lake and Fox lake, which are from four to seven miles in length and a mile or more in breadth. The others seldom exceed one or two square miles in area, and vary in character from quiet land-locked ponds to shallow, grassy marshes, differing but little from the ordinary wet prairie or slough. Indeed, almost every intermediate form between the two may be found in this region. The larger lakes, in many instances, are themselves widely margined with a growth of wild rice and various aquatic grasses and weeds, the matted stems of these, together with the floating confervoid vegetation, forming in some places a mass of sufficient buoyancy to support the weight of a man. When, however, this mat is once penetrated, a stick or an oar may sometimes be thrust down for a depth of several feet, meeting with scarcely any more resistance than is furnished by its own buoyancy. There are in Lake county, including the smaller ones, some twenty or thirty of these lakes or ponds; their average extent is, perhaps, nearly one square mile.

Passing westward into McHenry county, we find much of the surface of the same character, but also a much greater proportion of prairie, both level and undulating. The wooded country becomes

more broken, even rising, in some instances, into what may be called, in this part of the country, hills of moderate elevation. The general characters of soil and timber continue about the same; the small lakes, however, so characteristic a feature in the adjoining county, are scarcely met with at all to the westward of the Fox river. The prairies of this county, which, including under this head the low-lying marshy tracts or sloughs, comprise probably two-thirds or a still greater proportion of its surface, show in themselves rather greater variety of soil and surface than those in the counties farther to the south. We have here the gently undulating or rolling prairie, a continuation of that of the counties lying to the south and west, with its dark-brown or blackish upper soil of varying depth, with a sandy or gravelly clay sub-soil, and with narrow strips of marsh or slough between the undulations. This is the general character in the southern tier of townships, and to a considerable extent, though less generally, in other parts of the county. In the central and in some other portions of the county, the surface of the prairie sometimes becomes less undulating, and even apparently level, though still preserving sufficient rise to afford good drainage. A good example of this variety of prairie surface may be well seen in the Kishwaukee prairie, and at one or two other places in the county.

Lastly, we have the before mentioned wet prairies, or sloughs, which, combined, occupy a considerable area in this county. Small sloughs, varying in extent from one acre or less to several hundred, are found in all parts of the county, but the largest are in the northern tiers of townships. The soil of these wet prairies is generally more or less peaty, varying in composition from ordinary black swamp muck to true peat; its depth varies from one to twelve feet, and is sometimes even more.

The geological formations in this district comprise only the Drift, and of the older rocks, the Cincinnati and Niagara groups. The latter, however, are exposed at only two or three points in the district, everywhere else being deeply buried under the deposits of the Drift. These consist here chiefly of clay and hard-pan, with occasional beds of sand, gravel, etc., and with frequent boulders scattered throughout the mass. Its depth over the whole district will probably average at least seventy feet, being seldom less than that, and often much deeper. The best section is afforded along the lake shore, from Waukegan southward, where the exposed face of the bluffs, washed by the lake waves and constantly exposed to their wearing action, presents an almost continuous section of from

sixty to eighty feet perpendicular, for twelve or thirteen miles. In most places these bluffs appear to be entirely composed of clay and hard-pan, without stratification or any horizontal arrangement whatever, except in having the upper portion generally of finer material than the lower, as was observed in the continuation of these same bluffs southward, and mentioned in the report on Cook county. In some places, however, a kind of a rough stratification may be seen, rarely extending any considerable distance, and often so indistinct as to escape the notice of a casual observer. In the bluffs near Port Clinton, I observed the variation of the beds more by observing the line of springs, or the level at which the most of the moisture seemed to gather in the face of the bank, and to some extent also by the same means, farther to the northward. At one point, a little north of the city of Lake Forrest, I made out the following section. As the cliff was nearly perpendicular and unscalable, the thickness of the different beds are merely estimates; their relative thicknesses, however, are comparatively unimportant, as at no two points were they exactly the same:

	Feet.
1. Clay	10 to 14
2. Sand and clay intermingled	9 to 12
3. Clay	1 to 1½
4. Sand	1
5. Clay	50

I could not trace this section for more than a few rods along the face of the bluffs, as the different beds appeared to run out or to graduate into each other in such a manner as scarcely to be detected. Farther to the northward, between this place and Waukegan, I noticed bands or strata of different colored clays in the upper portion of the bluffs, at one or two points.

Irregular pockets of sand and gravel, sometimes with a kind of rough stratification of the contained material, and large and small boulders of nearly all kinds of rock, are scattered abundantly throughout the hard-pan and clay of which the cliffs are mainly composed. One of the largest of these boulders was seen on the beach at the foot of the cliffs, a little north of the southern line of Lake county. The material of the mass is a light-blue or drab-colored close-grained impure limestone, containing a few silicified crinoidal stems, etc., but not enough of fossil remains to determine the age of the beds from which it was derived, though it is probably from some of the Silurian rocks of Wisconsin. Its dimensions I was unable to take with accuracy, as it was deeply bedded in the sand and partly covered by a landslip from above, but the exposed portion was about ten feet by six or seven on its upper surface,

standing three or four feet above the beach. Its upper surface was polished but not level, and showed striæ in nearly all directions, but with the deepest ones and largest number in the direction of its greatest diameter. Other smaller masses of the same rock are frequently found with two or more sides flattened and striated, and it seems quite possible that this larger mass, if fully exposed, might show other similar striated surfaces to the upper exposed one. Most of the large boulders are of limestone; the masses of the primary or intrusive rocks are generally of comparatively small size, or when of considerable size, are but rarely met with. Passing away from the immediate vicinity of the coast, where the frequent deep ravines afford an occasional view of the lower clays, we find no good sections of the Drift in Lake county. There are no natural exposures, and all the data which can be obtained from wells, etc., are meagre and unsatisfactory. They seldom penetrate more than forty feet, and but little is met with but blue clay or hard-pan, with an occasional pocket or irregular seam of quicksand or gravel. Boulders, however, are tolerably abundant on the surface, and are also met with in these excavations, many of them of considerable size and weight, and of nearly every material—granite, sienite, greenstone, trap, etc., as well as of the more recent sedimentary rocks, such as limestone and sandstone. In the western part of the county, near the Fox river, we find the ridges, in some places, to be largely composed of rolled limestone boulders. The same character has been observed farther south along the stream, and remarked upon in the chapter on Cook county. The material, judging from the lithological characters and contained fossils, is chiefly derived from the beds of the Niagara group, to the northward, in the State of Wisconsin.

In the northeastern part of Lake county, along the bluffs north of Waukegan, the Devonian beds of Wisconsin appear to have contributed largely to the debris of the Drift, for in a collection of fossils, all more or less worn but mostly recognizable, which had been picked out of the gravel beds of this region by Mr. J. W. Milner, a very enterprising and zealous resident collector, I noticed a very large proportion of Devonian species, apparently of the age of the Hamilton group.

In McHenry county we find this formation presenting much the same general characters as further to the eastward. In the vicinity of Fox river the same kind of gravel ridges are met with as those which have been described as occurring in the western part of Lake county. In the central and western portions of the county the mass of the Drift appears to consist of clay and hard-pan, with occasional boulders.

We have, however, in this county accounts of logs of wood and other vegetable remains being found at various depths in these deposits, a feature which appears to be wanting, or extremely uncommon, in Lake county. One such instance, of the finding of a cedar (?) log, seven inches in diameter, at the depth of forty-two feet below the surface, is reported on the land of Mr. Thos. Duffield, near the eastern line of section 13, township 44, range 6. Other instances are reported in various parts, at depths varying from fifteen to fifty feet or more. Such of these tree trunks, etc., as are found within fifteen or twenty feet of the surface may, perhaps, belong to a later period than that of the mass of the Drift, but those which are met with at depths of forty or fifty feet, or even more, cannot, it seems to me, be properly so referred.

Niagara Group.—This formation, probably, underlies the whole surface of the district, with the exception of a narrow strip along its western border; its outcrops, however, are limited to two or three localities. For this reason, therefore, its boundaries can be determined only approximately, by lines drawn from localities beyond the limits of the district. The outcrops, judging from the character of the rock, appear, with perhaps one exception, to be confined to the upper or middle portion of the group, and are as follows:

In the northwest quarter of section 31, township 44 north, range 11 east, on the land of Mr. Thomas Rawson, a ledge of light-gray limestone, weathering to a pale yellow or buff color, has been opened to a limited extent. The exposure is not natural, the top of the ledge having been originally covered with earth to the depth of a foot or eighteen inches, and was only discovered as late as the year 1867. The depth of the excavation is about six feet, the rock showing no signs of stratification whatever, but becoming rather darker in color and more dense in the lower part of the exposure. Although in its upper portion the stone seemed to be almost entirely made up of disintegrated organic remains, but few fossils were collected—a few corals and an internal cast of *Caryocrinus*. A half a mile west of this point, in the northeast quarter of section 36 of the adjoining township, the same limestone is said to have been met with at the depth of four feet.

About five miles due north of this locality, in the northwest quarter of section 1, on Mr. Watson Converse's place, a bed of limestone rock was struck in two separate places, in digging wells—in one at the depth of only five and a half feet below the surface. A few flakes of the stone were turned up, and were to be seen on the surface at the time of my visit—a rather even-textured, light-drab

or buff limestone, containing imperfect casts of *Pentamerus*. If this limestone is here in place, and, judging from the account of Mr. Converse, I think it quite probable that it is, it may, perhaps, belong to a considerably lower horizon than that of the other localities in the district. In general appearance, the specimens of the stone which were seen were not very different from some of the beds exposed on the Fox river, in Kane county, which were there referred to the lower part of the group.

The only remaining locality where the beds of this age have been exposed at the surface, is in the northeast corner of section 17, township 44, range 9, and nearly on the county line between McHenry and Lake counties. The limestone is here seen in the sides and bottom of a shallow excavation on the roadside, about ten or fifteen feet in diameter. In general appearance and texture it is the same as that at Mr. Rawson's, except that at this point, being somewhat more exposed to atmospheric and other wearing influences, it is softer and more disintegrated. No well preserved fossils are contained in this rock, a few imperfect casts of corals and crinoids, and a single specimen of *Strophomena rhomboidalis*, only, were obtained.

At a place called the Sand Hills, on the Kishwaukee, in the southwest part of section 21, township 44, range 6, a bed of limestone was reported to have been struck at the depth of fourteen feet below the surface. This, also, probably belongs to the Niagara group, as we have no reason to infer that the other formations extend so far to the eastward.

Cincinnati Group.—This formation, as nearly as we are able to judge, underlies a narrow strip of territory running nearly due north and south, near the western border of this district. Its exposures are restricted to one locality, about two miles east of Garden Prairie station, on the Chicago and Northwestern railway, Galena division, and about a quarter of a mile south of the main wagon road, between that place and Marengo. It is here extensively quarried, the excavations being twelve feet or more in depth. The rock is a thin-bedded buff limestone, having frequently a slight bluish tinge, and containing much chert in some parts of the quarry. In general appearance it is very similar to some of the lower beds of the Niagara, to which group I was at first inclined to refer it. Fossils appear to be scarce; only a few imperfect fragments were obtained.

It is just possible that I have drawn the dividing line between the Niagara and Cincinnati groups too high up, and that these beds should be properly considered as forming the base of the upper Silurian. In referring them, however, as I did, I was influenced by their resemblance to undoubted Cincinnati beds farther to the westward, as well as by the position of the outcrop. We frequently find, moreover, in this part of the State, a greater or less similarity in the beds on both sides of the line of separation of two members of the Silurian, lying conformably one upon the other, and occasionally what appear to be beds of passage between the two.

Besides the Niagara and Cincinnati groups, which we know to underlie portions of the territory of this district, the Galena limestone may possibly be also found to occupy a very narrow strip along its northwestern border. As, however, I am aware of no outcrops or exposures whatever of this formation in the district, and its presence here is only inferred from the facts afforded by the exposures in the adjacent portion of Boone county, directly to the westward, this bare mention of it may be sufficient in this report.

Economical Geology.

Building Material.—The only stone quarry of any extent within the district is that which has just been described under the head of Cincinnati group, a little distance east of the western line of McHenry county. The rock here is generally too thin-bedded and contains too much chert to serve all purposes as a building stone, but nevertheless answers well for foundations and for the rougher kinds of masonry generally. In the other localities where the beds of rock appear they have been worked only to a very slight extent, and for the manufacture of lime alone. It does not appear, moreover, from the nature of the rock itself, that any very good building stone will ever be obtained from the most of these outcrops. In many parts of the district the erratic boulders of the Drift are used more or less in rough masonry, and in some places along the Fox river boulder quarries, so to speak, are worked in the ridges which have been mentioned before as being largely made up of loose masses of limestone rock.

Good clay for making brick is found in most parts of the district, although in some instances the same difficulty is met with as in Cook county—the clay contains too large a proportion of lime or limestone pebbles to make a good article. The prevailing color of the brick made in this district is red or reddish-brown. A white or

straw-colored brick is made, however, at Woodstock and at McHenry, in McHenry county. At Woodstock the clay from which the white brick is made is obtained under a peat bed, and may possibly be a sedimentary formation more recent than the Drift. That at McHenry I am inclined to think belongs to the Drift proper. The same clay that is used for making the white brick at Woodstock is used also for the manufacture of drain tile, and is said to answer well.

Lime is burned from the limestone boulders which are abundant in many parts of the district, and has also been manufactured from some of the limestone outcrops, but no very extensive manufacture of it has been attempted in either of the two counties. Sand and gravel, for mortar and concrete, are generally sufficiently abundant in all parts of the district.

Peat.—This material is found, in a greater or less extent, in all parts of the district, but the most extensive deposits are found in its northern half. The different bogs or sloughs in which these deposits exist are so numerous and scattered that it is difficult to give more than an approximate estimate of the area they occupy. Perhaps, taken altogether, four or five thousand acres would be a sufficiently low estimate. Only a few of the sloughs have been at all examined as to the quality and depth of the beds.

One of the largest of the sloughs is that which may be seen in sections 7 and 8, township 46, range 7, a little north and northeast of Hebron station, on the Rockford and Kenosha division of the Northwestern railway. From this point it extends, with some interruptions, several miles in a general southwest direction to the Nippersink, and probably occupies altogether an area equal to two or three square miles. The depth, where I was able to observe it, averaged from six to ten feet; the peat ranging from a light, fibrous substance of a reddish-brown color to a denser dark-colored material of a considerable specific gravity when dried.

Most of the other sloughs are of comparatively small size, varying from one to two or three hundred acres in extent. In the eastern part of Lake county the low and marshy tract along the shore of Lake Michigan, north of the city of Waukegan, includes in its area a large proportion of peat bog, much of it of considerable depth. A very large proportion of the area in the district, now occupied by these deposits of peat, is so situated as to be capable of drainage, and nearly all can be made use of, to a greater or less extent, for the purpose of pasturage, etc.

In regard to the value of the material as an article of fuel, we have the testimony of those who have used it, generally in its favor. It has been used to a considerable extent in the brick and tile works of E. B. Durfee, Esq., at Woodstock, both in the kilns and in the furnace of a stationary steam engine, and in both cases is reported to have given entire satisfaction. I am not aware of its having been made use of for these purposes at any other place in the district, but it has been used to a greater on less extent for domestic firing in various parts, and is generally said to answer well. Its use, however, in most places, has been only experimental as yet, and it will probably be a long time before it will come into general use as a fuel, even in limited districts. In some portions of the district this material has been used to a slight extent as a fertilizer, and when composted with other substances, and allowed to stand for a season before using, it has been found beneficial to some of the varieties of soil.

None of the more useful minerals have as yet been discovered in any quantity in this district, nor is it probable that any extensive deposits will ever be discovered. The soil, however, is generally productive, and the lands in all parts of the district are generally readily accessible to good markets. Timber is generally abundant, and, except in the vicinity of the several railroads, scarcely less so than when the country was first settled.

In closing this report, I must here express my indebtedness to various citizens of McHenry and Lake counties, and especially to Mr. J. W. Milner, of Waukegan, for kind assistance and information voluntarily afforded during the prosecution of the field work in this region.

CHAPTER XIX.

KENDALL COUNTY.

Kendall county is bounded on the north by Kane county, on the east by Will county, on the south by Grundy county, and on the west by LaSalle and DeKalb counties. It comprises an area of nine townships, or about three hundred and twenty-one square miles, of which about one-sixth is wooded and the remainder is prairie. It is watered by the Fox river, which traverses the northern and northwestern portions of the county, and by several smaller streams, the largest of which are Au Sable and its branches, the Blackberry, Big Rock and Little Rock creeks. The water supply of these streams in this county is chiefly derived from surface drainage, and to a very limited extent only from springs, therefore the smaller ones are nearly or quite dry during seasons of drouth.

The general character of the surface of the country in this county is that of an undulating prairie, with the timbered portions either in isolated groves or skirting the principal streams. Sloughs or flat damp meadows frequently occupy the hollows between the high rolling prairies, but are not often of any considerable extent. It is in these sloughs that most of the streams which head in this county take their rise. Along the Fox river, which flows in a valley one hundred feet or more below the general surface, the country is more broken, the alluvial bottom lands along this river are nowhere of any considerable extent, being seldom of more than half a mile in width, and for much of its course through this county the Fox runs through precipitous banks, coming to the water's edge, without even a narrow strip of bottom land.

The principal varieties of timber found in this county are similar to those in the adjoining counties. On the uplands we find the woods consisting chiefly of black, white, red and burr oak, shell-bark and bitternut hickory, black walnut, butternut, white and slippery elm, white ash, iron-wood, white and sugar maple, and on the lower grounds, in addition to most of these, we find black ash, cottonwood and occasionally a sycamore. The red cedar is also frequent

along the banks of Fox river, though it forms no large portion of the timber. The undergrowth is pretty constantly of hazel, with wild plums, crab-apple, and other small trees. The soil of the timbered tracts is generally light-colored, sometimes sandy, or gravelly clay, often somewhat darkened in color by an admixture of vegetable matter. On the prairies the soil is mainly a dark-colored mould, but containing in some places a proportion of sand and clay, especially near the borders of the streams and woods. The depth of this soil varies from one to three feet.

The deposits of the Drift epoch in this county are in all respects a continuation of the region adjoining on the north, and over the greater portion of it will probably average very nearly the same thickness, viz: from fifty to one hundred feet. In the extreme southern portion of the county there are districts where these deposits are comparatively quite thin, but over by far the greater part they are seldom passed through by even the deepest wells. Excepting the Fox river and the Au Sable, none of the streams cut down to the older rocks for any great part of their course, although they sometimes have cut ravines sixty or eighty feet below the general level of the country. The beds of this age consist here, as elsewhere, of blue and yellow clays and hard-pan, with occasional seams of quicksand and gravel and frequent boulders. In two places in this county I have noticed faint glacial striæ on the exposed surface of the underlying beds of the older rocks. One of these was on Big Rock creek, near the southern half of section 1, township 37, range 6 east, where the top of the uppermost strata of an exposure of Niagara limestone was worn smooth and covered with faint scratches, running in the direction of south 60° east. The other locality was in about the center of section 9, township 35, range 8, where a ledge of limestone of the Cincinnati group appears in the bed of the Au Sable creek. At this point the direction of the striæ was different, being about southwest.

Along the Fox river the materials of the Drift appear to have undergone a sifting and re-assorting process, by the action of the river, the bluffs frequently presenting sections of roughly stratified sand, coarse gravel and boulders, with sometimes a bed containing fossil fresh-water shells of existing species. A good section of this modified Drift materials is afforded by the cutting down of the bluff for the grade of a road near the center of section 4, township 36, range 6, about ten and a half miles south of Plano, where also a bed of shell marl is to be seen, intercalated between very irregular layers of sand, gravel and limestone boulders.

Of the older geological formations, we have the following, named in descending order:

1. Coal Measures.

2. Niagara Group. Buff, drab and brown impure limestones, with frequent nodules of chert. Aggregate thickness in this county, probably between fifty and seventy feet.

3. Cincinnati Group. Gray and bluish limestone, with green and blue shales. Total thickness, not over two hundred feet.

4. Galena and Trenton limestone. Porous yellowish limestone, with some bluish beds near the base, and beds of passage into the next formation below. Total thickness estimated at about two hundred feet.

5. St. Peters sandstone. Very incoherent white sandstones, brought up by anticlinals.

The accompanying reduced section, taken along the Fox river in its course through this county, shows all of these formations, except the first. The only outcrops of the St. Peters sandstone are where it is brought up by anticlinals on the lower course of the river in this county, as represented in the section.

The Coal Measures probably underlie a small area of not more than three or four square miles in extent, in the extreme southwestern corner of the county. The underlying rocks are nowhere exposed above ground in this vicinity, but the existence here of deposits of this age, is inferred from the strike and dip of the exposures in the adjoining counties of LaSalle and Grundy, and not from any evidence afforded within the limits of this county. It seems highly probable, however, from the fragments of coal, etc., found in this Drift, that at one time most of the southern portion of Kendall county was overlaid by deposits of this age, which have been carried off by erosion during the Drift period, and it is possible that small outliers may still exist, under the heavy bed of Drift clay and gravel which overlies nearly the whole surface of the county. The only

exposure which can in any way be referred to this period, is in the northeast quarter of section 16, township 35, range 8, very near the section line between sections 15 and 16, where we find a thin-bedded bluish sandstone, overlying the gray fossiliferous limestones of the Cincinnati group, in the bed of the Au Sable at this point. The sandstone can be traced for only a few rods, and the exposure is in no place good, it being generally almost buried in mud and water. In making an excavation on the bank of the creek at this point, Mr. House, the owner of the land, found many fragments of coal, with fire-clay, and fossil plants underlying a yellowish rotten limestone, reported to be four feet thick, which seemed more like a mass of loose fragments washed together, than like a bed of rock in place. About a mile north of this point the rocks of the Cincinnati group again appear, no intermediate exposures being seen.

Niagara Group.—This formation, judging from the outcrops, occupies a considerable area in the northern and northeastern portion of the county. From the scarcity of outcrops, however, it is difficult to bound this area with exactness, the junction between it and the next being only seen on the Fox river, at Oswego. Its southern border may be approximately represented by a line entering the county in the northeast corner of section 18, township 37, range 6, and running in a direction a little south of east, to the Fox river, at Oswego, then bearing gradually more and more to the southward, until it leaves the county in the southeastern corner of township 36, range 8. The general direction of this border line of this formation is inferred from widely separated outcrops, some of them outside of the limits of Kendall county.

At Esq. Shoutz's quarry, on Big Rock creek, near the centre of the southern half of section 1, township 37, range 6, about twelve feet of the regularly bedded light-buff or drab limestone of this group is exposed. It here contains much chert in irregular seams and concretions, especially in the lower part of the exposure, the upper two or three feet being almost entirely free from this substance. Above the quarry, at the mill-dam, this rock forms the bank of the creek, in ledges rising some seven or eight feet above the water, and may still be seen above water for about thirty rods above the dam. Further up stream, the rock continues under the bed of the creek to beyond the county line, but is not again exposed in the bank in this county. Below the quarry, it appears in the bed of the creek for between a quarter and a half a mile, before finally disappearing entirely, and at several points within this distance there are limited exposures in the banks. In none of these

exposures is there any noticeable dip of the strata, and the level surface of the upper beds in the quarry is covered with the glacial striæ, which have been already mentioned in the preceding pages. Fossils are not abundant in any of these localities, but *Halysites catenularia*, *Favosites favosus*, *Calymene Blumenbachii*, an *Illænus* and a few other species were collected.

Eastward from this point, no prominent exposures or ledges of rock are met with, until the Fox river is reached. At the point where the river crosses the Kendall county line, just below the village of Montgomery, a ledge of yellowish limestone containing much chert appears on the right bank of the river, rising to a height of seven or eight feet above the water's edge. From this point down stream nearly to Oswego, there is very little exposure, the rock appearing only below high-water mark, and in the bed of the stream. Just north of the village, near the southern line of section 8, township 37, range 8, the thin-bedded limestone of this group is quarried in the bottom and sides of a small ravine. The lower eight or ten feet of the rock, which is quarried near the river bank, is mainly of a light-buff color, with some portions of the strata approaching to a gray, and with a few thin seams of bluish cherty rock very nearly resembling true chert in appearance, and breaking with its conchoidal fracture. Farther up the ravine, we find above this six or seven feet of a rather darker colored, thin-bedded limestone exposed. No fossils were obtained from any of the beds in this locality.

Across the river from this point, there is a rather more extensive quarry in apparently the same bed of limestone, which is worked both for building stone and for material for the manufacture of lime.

In the village of Oswego, in a perpendicular face of rock on the bank of the Waubansia creek, a few rods below the bridge, about five feet of the lowermost beds of the Niagara limestone may be seen, resting directly upon the strata of the Cincinnati group. The rock here is a brownish, ferruginous limestone, and contains a few fossils, chiefly corals, *Stromatopora concentrica*, and a Zaphrentis, being most abundant. Thin seams of chert traverse the rock here, as in the other localities. The dip of the strata here is to the eastward, about three or four degrees, thus bringing to view a greater thickness of these beds further up the stream. A little above the bridge, near the lime kiln, and still farther up, there cannot be less than twenty feet in exposed vertical thickness, of the Niagara limestone, in the sides of the ravine.

The only remaining exposure of rocks of Niagara age in this county, is on Waubansia creek, in the northern part of section 16, a little over a mile from Oswego. At this point, the rock underlies the prairie at a very slight depth, over an area, probably, of several acres, and is exposed in the bed of the creek, and in the artificial excavations of the quarries. This exposure is of a light-buff or drab thin-bedded limestone, containing some shaly layers. It also contains, in some of the upper layers, many small nodules of iron pyrites. The whole depth of the excavations in the rock at this place was not more than four feet at the time of my visit, and for this reason I could not compare this exposure with some others in this county as satisfactorily as I could wish, but I consider it as higher in the formation than any of them, probably fifty feet or more above the base.

Fossils were neither abundant nor well preserved at this locality; a few fragments of Trilobites and corals, only, were collected.

Cincinnati Group.—This formation occupies a considerable area, lying south and west of that underlaid by the Niagara group, equal, perhaps, in extent to one-third of the whole superficial area of the county. Its western border would, perhaps, be nearly represented by a line running from north, northwest to south, southeast, and crossing the Fox river in the southeast quarter of section 35, township 37, range 6. The line of junction between it and the formation next below is not shown anywhere in Kendall county.

The upper beds of this formation are well exposed at Oswego, directly underlying the lowermost strata of the Niagara group. The following section of these beds was taken on Waubansia creek, in the same place which has been already noticed as a locality of the Niagara lower beds. Commencing at the base of the Niagara limestane, about five feet below the top of the bank, the strata were as follows:

	Feet.
1. Gray or bluish-gray limestone, with chert, apparently destitute of fossil remains..	3
2. Gray limestone	7
3. Soft bluish shale	1
4. Gray limestone	2

A little farther down the creek the gray limestone (No. 4) is better developed, and contains many fossils. The rock is a hard, sub-crystalline, thin-bedded limestone, with even, thin, shaly layers, and is considerably quarried at this point as a material for the rougher kinds of masonry. The most abundant fossils in this locality are, *Tentaculites Oswegoensis, Rhynchonella copax, Orthis occidentalis, Orthis bellarugosa, Strophomena alternata, S. deltoidea, Chætetes petropolitana,*

and various crinoidal remains. On the opposite side of the river from the village, at the western extremity of the bridge, there is also an exposure of about twelve feet in vertical thickness, of thin-bedded grayish limestone, containing, at this point, considerable chert in lenticular and irregularly flattended masses. It has been quarried here to some extent, and has afforded some very fine crinoids. These same beds of grayish cherty limestone continued to be exposed in ledges near the water's edge, on both sides of the river, for some little distance below the bridge, but are not quarried elsewhere.

Below Oswego, along the Fox, the beds of the Cincinnati group, with occasional interruptions, continue to appear in the bank of the river. The exposures are of shale, with thin beds of limestone more or less abundant, and in many places, indeed, the limestone forms the greater part of the outcrop, the shale only appearing as partings between the thin beds of stone. In a few places the exposures consist entirely of bluish shale, as, for instance, in the bed of Morgan creek, in the southeast corner of section 27, township 37, range 7. The beds of limestone are rarely sufficiently heavy to afford a good material for building, and are therefore worked in a very few places. The thin plates of limestone are often covered with the more abundant fossils of this formation, as, *Rhynch. copax*, *Orthis occidentalis*, *Orth. testudinaria*, *Leptæna sericea*, *Strophomena alternata*, *Chætetes*, etc. At Yorkville and Bristol these thin beds of limestone are exposed, at the ordinary stage of water, along the bank of the river, and contain the same fossils as the exposures above.

At the mill-dam on Blackberry creek, in the village of Bristol, about ten feet of perpendicular grayish crystalline limestone, with some hard bluish shaly rock, is exposed. About thirty rods above, on the southern bank, is a small quarry, in which about four feet of the limestone is exposed. The beds of this limestone are here of sufficient thickness to afford a tolerable material for foundations and rough walls. Its color is a dark grayish-blue on weathered surfaces, sometimes appearing buff or brown. In this locality, besides the species already noticed as abundant in other beds, there are found many large *Orthocerata*, and a great abundance of *Ambonychia*, together with numerous fragments of *Trilobites*. The limestone, with some intercalated beds of bluish shale, continues to appear in the bed of the creek, for upwards of half a mile above this point, before it finally disappears under the Drift.

Below Yorkville and Bristol I observed ledges of this formation continuing, with occasional interruptions along the banks of the

river for nearly three miles, and presenting much the same appearance as those already described as occurring along the river above Yorkville, but with, perhaps, a greater predominance of shale, as compared with the limestone. Just below Yorkville the river bank shows some fifteen or twenty feet, in vertical exposure, of crumbling shale and rock, and an equal amount may be observed at other points below. Some of the thin layers of rotten limestone at this exposure, are extraordinarily rich in certain species of fossils, chiefly *Trilobites*, *Calymene senaria*, *Asaphus*, etc. The last appearance of these beds, down stream, is at a point not quite three miles below Yorkville, in the southwest quarter of section 36, township 37, range 6.

The outcrops of this formation which remain to be described in this county are on the Au Sable creek, in township 35, range 8. The intermediate prairie is entirely destitute of outcrops, and, except in the immediate vicinity of the Au Sable and Fox, no rock in place has been reached by any artificial excavation. The northernmost of the outcrops of this group on the Au Sable occurs in the bed of the creek, very near the centre of section 9, and is only visible at low water. The ledge, which is of very limited extent, is of an apparently massive gray crystalline limestone, containing a few characteristic fossils, among which I noticed *Rhynchonella copax* and one or two other brachiopods. The upper surface is smooth, and covered with faint striæ, which have been already noticed in the remarks on the Drift in this county. The next appearance of the rocks of this age is at the crossing of the county road, on the centre of the western line of section 15. Here, the bed of the stream at the ford, and for a few rods above and below, is composed of a thinly-bedded highly fossiliferous light-gray limestone, the beds dipping slightly (8° or 9°) to the northeast. The fossils here are the same as in the other localities described. About half a mile, in a direction a little east of north, from this place, on the southwest quarter of section 10, limestone, apparently the same as that exposed in the bed of the Au Sable, was reached, at a depth of ten feet, in digging a well.

In the bed of the Au Sable, near the southern line of section 15, a dark-colored shale, or shaly limestone, is exposed, which affords many fossils. A little farther down stream, at the ford and below, the bed of the creek is composed of a bluish-gray thin-bedded limestone, which is likewise fossiliferous. By a boring which was made by Mr. Durst, at his place near the center of the western line of section 22, and half a mile from the creek, the following section was afforded:

	Feet.
1. Surface soil and clay	7
2. Hard, bluish-gray limestone, reported by Mr. Durst to be the same as that occurring at the crossing of the Au Sable, half a mile west	17
3. Hard, thin-bedded bluish limestone, with shaly partings, said to contain, in its upper portion, about two inches of black, coaly matter, probably bituminous shale.	54

I have not positively identified the lowest beds (No. 3) of this section, in any of the surface outcroppings along the creek, although they probably appear at some points in its bed farther down stream, in this or the adjoining county.

Below this point the rock does not appear continuously in the bottom and banks of the stream, but is covered in most places with mud and gravel. The nearest points where it appears prominently in the bed of the creek, are the southwest corner of section 23 and the center of section 27. In both of these places, at the time of my visit, the stage of the water was such that the strata were not visible, but from pieces thrown out upon the bank, I considered the rock in this place to be the same as that in the localities above named. Further down stream, at the crossing of the old stage road from Joliet to Ottawa, just west of the center of section 34, I observed ledges of thin-bedded limestone appearing in the bank to the height of three feet or more above the water. The upper beds are light-gray, inclining to a buff color, while some of the lower layers are dark-gray and bluish. At the county line, a half-mile further south, rock again appears in the bed of the creek, a highly fossiliferous, bituminous limestone, dark-colored, almost black on freshly-fractured surfaces. The general dip of the strata in all these localities is towards the northeast, although it is so slight as not to be everywhere apparent.

Trenton Group.—This formation, consisting, as has been stated, of heavy-bedded yellowish and blue limestone, occupies all of that portion of the county which has not already been described as underlaid by the more recent formations, with the exception, perhaps, of a very small fraction of township 35, range 6, in the southwestern part, which may be underlaid by the St. Peters sandstone. Its outcrops are confined to the banks of Fox river, and a small area in the southern part of the county, in township 35, ranges 6 and 7.

At Post's mills, near the mouth of Big Rock creek, in the southwestern part of section 34, township 37, range 6, a quarry has been opened in this rock, to a depth of almost five feet. It is here a light-buff or yellowish, porous limestone, the more solid portions showing a grayish hue on freshly fractured surfaces. The beds lie apparently level, as no dip in any direction is perceptible at this point. The same beds appear in the bed of Little Rock creek, near

the quarry, and have been uncovered at one time half a mile farther up the stream, though not now visible. Fossils were rare at this quarry, and when found were generally ill-preserved. A few fragmentary *Murchisonia* and *Pleurotomaria*, only, were obtained.

Above this place, according to Mr. Post, this limestone may be found in the bed of the Fox, as far as the mouth of Rob Roy creek, in the southwestern quarter of section 35, township 37, range 6, and it appears in a ledge, visible at low water, in the left bank of the river, in the southwestern quarter of section 34.

About half a mile below Post's mills, on the right bank of the river, in the northwest quarter of section 3, township 36, range 6, there is another quarry, on the eastern side of a small knoll which rises a few feet above the general surface of the bottom land. In this quarry I observed the beds dipping towards all points of the compass, from north around to the south by east, and, from appearances, it seems probable that if the rock was exposed on the western slope of the knoll, it would be found dipping in that direction also. One or two other similar knolls, or slight elevations, occur within a short distance from this, and in one of them, also, the rock has been quarried and presents similar appearances. The rock is the same as that worked at Post's mills, a porous, yellowish, limestone, full of traces of organisms, but affording very few well preserved fossils. Those collected here were mostly imperfect casts of *Illænus*, *Pleurotomaria*, *Murchisonia*, *Subulites*, and one or two small fragments of *Zaphrentis* and *Receptaculites*.

Nearly half a mile further down stream, at Black Hawk's Cave, in the eastern part of section 4, the river cuts through a ledge of this limestone, of which about 16 feet in thickness is here exposed. Black Hawk's cave is a name given to a natural crevice or a small cave in the rock, which formerly extended back into the ledge for some little distance, but which, with several other similar cavities in this ledge, has now been almost or entirely destroyed by the quarrying of the stone for the construction of a dam across the river at this point. At the northern edge of the exposure the strata dip down at an angle of five or six degrees. At the other side, on the contrary, the beds break off abruptly. On the right bank of the river the outcrops continue a few rods further down stream before disappearing entirely. The next appearance of the rock is on the right bank of the river, in the eastern part of section 8, where it is quarried for building purposes. It is here, as in the other localities, a light-yellowish porous limestone, crumbling in some of the uppermost layers, but becoming more solid and better as a

building material the deeper it is worked. It contains numerous nodules of chert, and casts of fossils, seldom, however, sufficiently perfect to be at once recognizable as to species.

Below this place for some distance the strata of this age are met with, and are doubtless tilted up by a small anticlinal, the crest of which has most probably been eroded away. The evidence of this fold is in the existence of an exposure of the underlying St. Peters sandstone on the opposite side of the river in the southeastern quarter of section 17, and above the next exposure of the Trenton group, and not by any decided dip of the strata in any direction.

One mile above Milford, on the right bank of the river, is Brodie's quarry, where a thickness of over twelve feet of the rock is exposed, a bluish-gray porous limestone, the lowermost beds the darkest in shade of color. This exposure is on the northeastern slope of still another anticlinal than that one before mentioned, the strata having an inclination of between twelve and fifteen degrees in the direction north 60° east. This is further proved by exposures of St. Peters sandstone along the river bluffs immediately below this point. Immediately above, at the edge of the water, the limestone may be seen for a short distance, the beds becoming less inclined and finally appearing nearly horizontal. Still farther down the river, below this fold, nearly on the north line of section 30, and between one-fourth and one-half a mile above Milford, on the right hand bank, I observed the following section:

	Feet.	In.
1. Coarse porous yellowish limestone	3	6
2. Hard siliceous rock, resembling quarzite	0	6
3. Light-gray or drab argillaceous shales, with thin layers of rock, same as No. 2	2	6
4. Light-colored shaly bed	2 to 4	
5. Impure yellowish limestone	3 to 5	

The arrangement of the strata in this exposure is very irregular and their order is somewhat changed, even within a distance of only a few feet from the point where this section was taken. I am at present inclined to consider these beds as very near the base of the Trenton, close to the junction with the St. Peters sandstone, and possibly indicating something like beds of passage between the two formations.

The remaining outcrops of this group in this county are to be found in the southern part of township 35, ranges 7 and 6. The westernmost of these occurs on the land of Mr. J. Bushnell, in the northeast quarter of section 36, township 35, range 6, a little over half a mile south of the village of Lisbon. The rock is exposed in the bed of a small rivulet at two points, about a quarter of a mile

apart. The most southern of these exposures is of a soft, brown, porous, decomposing limestone; in the other, the rock is harder and contains considerable chert. A fragment of a *Receptaculites*, and one or two other indistinct casts of fossils only, were collected here. The next nearest exposure is at Morris' stone quarry, in the southeast quarter of section 30, township 35, range 7, where the rock appears at the surface of the ground on one of the higher undulations of the prairie, and has been quarried for building purposes to the depth of about six feet. It is an unevenly-bedded porous yellowish or buff limestone, very similar to that described on the Fox river, at Post's mills, and, like that, contains very few good fossils. The strata here appeared to be nearly or quite horizontal.

A little more than a mile and a half east of Lisbon village, in the northeast quarter of section 29, the same beds have been again quarried, on the land of Mr. S. Peterson. About half a mile south of this quarry, on the banks of a small run, I noticed many freshly quarried fragments which had been taken out of its bed, but the strata in place were not visible at the time of my visit. The stone was similar in all respects to that already described, but was altogether richer in organic remains, containing very many specimens of *Receptaculites*, *Zaphrentis*, *Orthis testudinaria*, and various other fossils. Still farther down the course of the same run, in the northeast corner of section 32, just below the crossing of the county road, I saw low ledges of thin-bedded yellow or buff limestone, extending for a few rods in the banks of the stream.

East of these localities, no beds of rock appear above the surface of the prairie for between two and three miles, though it is evidently not buried very deeply. The nearest exposure in this direction north of the county line is nearly in the centre of the northern part of section 35, on the land of Mr. Lewis Sherrill, who has opened a quarry for building stone at this point. The rock is the same as at the localities farther west. Though not perceptible to the eye, the rocks here have a slight dip to the eastward, not more, probably, than twenty or thirty feet in a mile. The most eastern point where the rock appears at the surface is half a mile east of Mr. Sherrill's in a small ravine in the northeast quarter of section 35 and the southeast quarter of section 26. Still farther east, it has only been struck in wells.

St. Peters Sandstone.—From observations made in the adjoining parts of LaSalle county, it seems probable that a small area in the western part of township 35, range 6, is underlaid by this formation. The tract thus underlaid is of very inconsiderable extent, at most,

probably not more than one or two square miles, and includes portions of sections 18, 19 and 30, in the western part of the township. The only exposures of this sandstone in the county are those which have been incidentally mentioned in the remarks on the Trenton group, in the preceding pages, as occurring along the Fox river. In the centre of the southern part of section 19, township 36, range 6, on the western bank of the river, the principal one of these exposures occurs, the sandstone being brought up by an anticlinal, forming the base of the arch, and is exposed in excavations in the side of the bluff for thirty feet or more above the water. It is here, as elsewhere in this part of the State, a soft incoherent mass of white sand, hardly deserving the name of sandstone, so soft, indeed, as to be easily excavated at some points with a common spade. Another exposure of the same material in a similar situation was observed higher up stream, on the eastern bank, in the southern part of section 17.

Economical Geology.

Building Stone.—From what has been stated in the preceding pages, it will be seen that Kendall county is well supplied with building stone, although the finer qualities, suitable for cut-stone and ornamental work, are generally wanting. The proximity, however of the excellent quarries at Batavia and Joliet, will make up for this deficiency. The limestones of the Niagara group, in the northern part of the county, afford a good material for rough walls, foundations, etc., and have been used to some extent for general building purposes, though the beds are not always of sufficient thickness to supply the better qualities. At Mr. Shoutz's quarry, in the northwest part of the county, blocks of considerable size are sometimes obtained, but in many instances contain so much chert as to seriously impair their quality. The limestone beds of the Cincinnati group, which have been quarried to some extent along the Fox river at Oswego and Bristol, and also on the Au Sable in the southeastern part of the county, are found, wherever sufficiently resistant to the atmospheric influences, to afford a fine material for foundation walls, and for the rougher kinds of masonry generally. The heavier bedded limestone of the Trenton group affords a still better material for the same uses, and has also been employed for general building purposes, and found to answer well. It will readily be seen from

the descriptions of quarries and outcrops of rock in the preceding pages, that they are so distributed as to be easily accessible from all parts of the county.

Other Building Materials.—Limestone, suitable for the manufacture of a fair article of quick-lime, is found in both the Niagara and Trenton groups in this county. At Oswego, lime is made from rock of the former age, which appears here to be somewhat magnesian, and affords a strong, but not perfectly white lime. The limestones of the Trenton group are burned at Post's mills, and a little above Milford, on the Fox river, and also near Lisbon, and each of these places is said to afford a good article of lime. Another source of this material which has been made use of to a limited extent, is found in the collections of limestone boulders, frequently met with in the deposits of modified Drift along the Fox river.

Sand, for building purposes, is abundant throughout the county, and the sub-soil and Drift afford good clay for making the ordinary red-brick, which are manufactured in quantities to meet the local demands, at various places in the county. In this connection, I may also mention the white sand of the St. Peters sandstone, occurring along the lower course of Fox river, in this county, which, when free from mineral salts, by which it is sometimes deteriorated, affords one of the very best materials for the manufacture of glass.

Sulpur Springs.—Springs containing sulphuretted hydrogen occur in several places in township 35, range 8, in the southeastern portion of the county. One of the largest and best known of these springs occur on the land of Mr. L. House, a little southwest of the center of section 15. It is a clear, constant spring, and gives off an odor of sulphuretted hydrogen, which is perceptible at several yards distance, although the sulphurous taste to the water is not sufficiently strong to render it disagreeable to most persons; indeed, the reverse is very often the case. It is much favored by picnic parties, and from various relics which have been found in its immediate vicinity, it would seem to have been used as a watering-place by the aboriginal inhabitants of the county. Another similar spring, of less value, occurs close to Mr. House's residence, between a quarter and a half mile farther west, on the western bank of the creek, and still others, in the southern part of section 23, and in the northeastern part of section 16, in the same township. The formation in which these springs appear to have their source, is the Cincinnati Group.

Peat.—Small deposits of peat have been found in the prairie sloughs in various parts of this county, and also at one or two points along

the Fox river, but, with only one exception, so far as I am aware, they have not been tested as to their extent or value as fuel. On the western bank of Fox river, in the northeast quarter of section 4, township 36, range 6, there is a bed of this substance, which occupies an area of probably seventy or one hundred acres, or even more, which has been used to some extent in the neighborhood as fuel, and is reported to have made a good fire. This bed will, I think, average six feet or more in depth, over the whole area which it occupies, and is probably the most extensive deposit of the kind in the county.

From the small fragments of stone-coal, which are occasionally found in the Drift and surface deposits in this county, some persons have been led to suppose that coal-beds might be found under the surface. In regard to this, it can only be said, that there is no probability of the existence of any such beds under any part of the county, excepting, perhaps, a very small area in the extreme southwestern corner. It is possible, indeed, as has been stated before, that small outliers of the Coal Measure strata may yet exist under the Quaternary deposits in this region, and these might also be productive, but as we have no certain knowledge of their existence, the chances are too hazardous to warrant any expenditure of labor or capital in their search.

CHAPTER XX.

MORGAN COUNTY.

Morgan county is bounded on the north by Cass county, on the east by Sangamon county, on the south by Macoupin and Greene counties, and on the west by Scott county and the Illinois river. It comprises about fifteen and two-thirds townships, or about five hundred and sixty-three square miles, of which nearly or quite one-half is well-wooded, and the remainder is prairie. Besides the Illinois river, which forms a portion of the western border, this county is watered by several lesser streams, among which the Indian, Mauvaisterre, Sandy and Apple creeks may be mentioned as the most important. Nearly all these streams head in this county, and attain considerable dimensions before passing beyond its limits.

The country away from the immediate vicinity of the streams is, in most parts, a gently undulating prairie, with a rich, dark-colored surface soil, similar in all respects to that of the adjoining regions, and differing but little from the general character of all the prairie soils in this portion of the State. On the broken land along the streams the soil is generally lighter-colored and clayey, and generally bears a heavy growth of black, white and red oak, with some laurel oak, pin oak, bitternut and shell-bark hickory, black walnut and butternut, white and slippery elm, ironwood, sassafras, hackberry, red-bud, soft and sugar maple, linden and hazel. On the the narrow strip of level bottom land, which borders many of the streams, we find, in addition to many of the above species, swamp white oak, chinquapin oak, sycamore, paw paw and cottonwood. In the extreme western portion of the county the Illinois river is bordered by an extensive tract of bottom land, ranging from four to six miles in width at different points. In this bottom, with the exception of a few tracts of low sand ridge, covered with stunted black-jack, the

soil is a rich arenaceous loam, which, whenever sufficiently elevated, is one of the best soils in the county. A considerable portion of this bottom, however, is flooded by the Illinois river, and certain tracts are so little elevated as to form permanent shallow lakes or sloughs. Along the edges of the bluffs, at their immediate base, there is generally a sandy slope, similar in soil and timber to the sand ridges in the bottom, the material of which is derived from the marly sand of the Loess, of which the bluffs are mainly composed.

The Loess, the most recent of the geological formations after the Alluvium, occurs in this county only along the Illinois river bluffs, in which it attains a thickness of from sixty to eighty feet. Back from the bluffs it rapidly thins out, and is seldom seen extending more than a mile or two up the side ravines, and, indeed, it frequently disappears entirely within a much less distance. The material is generally an ash or buff colored marly sand, containing fossil fresh-water shells of existing species, here, as elsewhere, forming high conical bluffs, which constitute a peculiar feature in the landscape. So resistant is this material to atmospheric influences that many of the bluffs are crowned by steep mural escarpments of compacted sand, which preserve their shape from year to year in spite of the wearing action of the frosts and showers.

The deposits of the Drift extend over nearly the whole surface of the county, their thickness ranging all the way from twenty to eighty or one hundred feet; and at Jacksonville its thickness amounts to even one hundred and forty-seven feet. The material of this formation is generally a blue or yellow clay, with occasional seams or strata of quicksand or gravel. Good sections of this formation are, however, rarely met with, both on account of the infrequency of shafts or wells of sufficient depth, and of the frequent lack of reliable information in regard to those wells which have been sunk. In general, however, the brown clays are uppermost, and are underlaid by bluish clays and hard-pan. A little distance north of Prentice station, on the St. Louis, Jacksonville and Chicago Railroad, in the extreme northeastern part of the county, a shaft passed through eighty-five feet of the beds of the Drift, and the following section was reported:

	Feet.
1. Surface soil and brown and yellow clays	25
2. Bluish hard-pan	50
3. Sandy clay, containing a log eighteen or twenty inches in diameter	10

Logs and drift-wood are reported to have been frequently found in the clays, etc., of the Drift, in this county, but seldom as deep as in this instance, at the very base of the formation.

Boulders are abundant in all parts of the county, but in this region are seldom of such very large size as farther north. Many of the transported boulders show polished and striated surfaces on two or more sides, but no such surfaces were observed in any of the exposures of rock *in situ*.

The older geological formations which appear in the surface exposures of this county are the Coal Measures and the St. Louis limestone. Of the former, there is between the uppermost and lowest exposures a considerable aggregate thickness, it is difficult to state exactly how much, but probably several hundred feet, including the horizon of at least three or four workable coal seams. Of the St. Louis limestone only a limited thickness of the upper beds is exposed.

Coal Measures.—This formation underlies nearly the whole surface of the county, the only portion in which it is not the uppermost rock being a comparatively limited area along the Illinois bottoms and bluffs. We find considerable difficulty in forming a correct idea of the details of this formation in this county, on account of the wide separation and varying character of the different outcrops. The aggregate thickness, however, may, I think, be safely set down as not less than three hundred feet, and probably still more. Within this thickness there are at least three, and most probably four beds of coal of sufficient thickness to be profitably worked.

The only surface outcrops of No. 1, of the Illinois river section, are along the Illinois river bluffs, near the northern line of the county, in sections 2, 3 and 4, township 16, range 12 west of the third principal meridian, where it has been worked to a slight extent by drifts driven horizontally into the hillside, and it has, besides, been worked at least at one point by stripping along the outcrop.

The following section, which is made up in part from natural exposures in the northeastern quarter of section 3, and in part from information derived from the parties who had worked the coal, will serve to furnish an idea of the order and thickness of the beds at this point:

	Ft.	In.
1. Clay shale, containing a few indeterminate, apparently vegetable, impressions and passing downwards into the underlying bed	1	5
2. Arenaceous shale, containing no fossils, except perhaps a few crinoidal stems.	3	
3. Brownish sandstone, containing a few indistinct vegetable impressions	20	
4. Black slate	2	
5. Drab argillaceous shale (exposed)	5	
6. Drab argillaceous shale (reported)	2	
7. Coal	2	6
8. Fire-clay, penetrated only a few inches		

The sandstone No. 3 of this section has been worked to some extent as a building stone, and is exposed in several places along the river bluffs in this vicinity. The other beds are only to be seen at one or two points, and the outcrop of the coal itself is everywhere covered up by soil and debris from the beds above.

In the southwest quarter of section 4, township 16, range 11, it is reported that a coal bed occurs a few feet below the bed of Indian creek, which has been worked by stripping during seasons of very low water. A little distance below the point where the coal was said to occur, I observed masses of nodular argillaceous limestone, which I judged to have been derived from the under-clay of the coal. Still farther up the creek, in the northeast part of section 15, I observed an outcrop of a reddish concretionary sandstone, which may perhaps be the equivalent of the sandstone No. 3, in the above section.

McPherson's coal bank is situated in the northwest quarter of section 33, township 16, range 12. The distance from the surface of the ground to the bottom of the coal in the shaft is about twenty-six feet. After passing through fifteen feet of soil and drift clay, about eight feet of dark-colored shale and black slate, containing many heavy ironstone concretions, are met with, and still under this the coal—at this point only twenty inches in thickness. The fragments of black slate, which had been thrown out of the shaft, contained a few fossils, among which I recognized only *Discina nitida*, the others being mostly unrecognizable.

A bed of coal, which may possibly be the same as that in the localities already mentioned, is reported to occur in about the center of the western part of section 20, township 16, range 12, on the land of Mr. Harris. The coal is said to occur at a depth of about twelve feet below the bed of Coon run, where it has been struck by excavations, although it was found impossible to work it on account of the water. The bed of the creek, a short distance above this point, is composed of rather irregularly-bedded light-gray limestone; the beds, as far as I was able to observe them at the time of my visit, lying horizontal, or very nearly so. Below, along the banks and bed of the stream, in the eastern part of section 19, there appears a light-colored, shaly limestone in the bed of the stream, and about two hundred yards still farther down stream, but higher in actual position, heavy beds of a soft, massive, ferruginous sandstone appear in the sides of the ravine. I am, however, inclined at present to think that these beds may possibly belong to the upper part of the St. Louis group, and not to the Coal Measures, though the

lack of fossils and the want of continuity in the exposures, make this a rather difficult question to decide with certainty.

The coal No. 2, of the Illinois river section, is worked in this county at one of its typical localities, and probably at several other points also. At Neeleyville, on the Toledo, Wabash and Western Railroad, near the western border of the county, this seam of coal immediately underlies the Drift, at a depth below the surface, at the principal diggings, of from ten to fifteen feet. A shaft sunk upon the top of the hill, however, a short distance south of the railroad, passed through eighty-five feet of the brown and blue clays of the Drift before reaching the coal. The seam varies from four feet two inches to four and one-half feet in thickness, of which, however, only about three and one-half feet is available—from eight inches to one foot of the coal being required to be left to support the roof.

In the eastern part of the village a shaly sandstone, varying in color from light-reddish to gray, is exposed in the bottom and sides of the ditches along the railroad for a distance of three hundred yards or more. The whole thickness exposed is not over eight feet, and the beds appear to be very nearly horizontal. From the locality and appearance of this sandstone or sandy shale, I am inclined to consider it above the coal in stratigraphical position. If otherwise, its presence here must be due to a fault, of which we have no other evidence.

Other localities, of probably this same seam of coal, are in the northwest corner of section 34, township 16, range 12, and in the southern part of sections 21 and 22 of the same township. The former of these localities is on the land formerly owned by Mr. Robert McPherson, and the coal is said to have been worked by drifting into the side of a small ravine. The bed was reported to be about four feet in thickness. No satisfactory information as to the overlying beds could be obtained. This coal bank is distant about half or three-quarters of a mile from McPherson's shaft, already noticed as a locality of the lowest seam, No. 1, of the Illinois river section. Its level is probably from forty to fifty feet above the coal seam opened by the shaft. In the southeastern quarter of the same section I observed exposures of arenaceous shales and shaly sandstone, which I judged to be the overlying beds of this coal, and at one or two points the exposures were from ten to fifteen feet in vertical thickness.

In the southern part of section 22, the workings were scattered along the bank of Coon run, for a distance of about half a mile.

The coal was worked by horizontal drifts in the side of the bluff, all of which have been long disused, and few particulars as to the seam itself, or its surroundings, could be obtained. It was reported to be three feet or more in thickness. A short distance below the coal diggings, limestone is reported to occur in the bed of the stream, but this was not visible at the time of my visit. It is possible that the coal in this locality may be No. 1, although, from the position of the diggings, I had thought it more probably No. 2.

In the northwest corner of section 18, township 15, range 11, at the point where the Toledo, Wabash and Western railroad crosses the *Mauvaisterre*, there is an exposure on the side of the bluff and in the railroad cutting of thirty feet or more of shaly sandstone and arenaceous shales. The shaly beds may be traced along the stream for a distance of between a quarter and a half a mile from the bridge, where they finally disappear, and above this point along the stream, and indeed in the whole northeastern portion of the county, there are no prominent exposures of any of the beds of the older formations.

On Willow Branch, in the southeast quarter of section 19, township 15, range 11, I observed the following section, in a small quarry near the road crossing:

	Feet.
1. Shale, slightly argillaceous at top, and passing downwards into a shaly sandstone, containing concretions with indistinct vegetable impressions	6
2. Massive, brownish-white sandstone, containing a few imperfectly preserved impressions of plants	12
3. Clay shale, only exposed at one or two points in the lower bed of the quarry	6 or 7 in.

No. 2 of this section is the bed, which is here worked as a building stone. It is extremely soft and easily worked when first taken out, but is said to harden on exposure to the weather. It is considerably used for general building purposes in the vicinity. Below the quarry, exposures of shaly sandstone and arenaceous shales occur along the banks of the creek, wherever it touches the bluffs which edge the narrow bottom, as far as the county line, a distance of about one mile, and probably continue to appear along the lower course of the branch in Scott county. Above the quarry, there are no prominent outcrops, although the same beds undoubtedly occur in the hillsides. At one point only, in a ravine running down to the creek, in the northeast part of section 29, I observed indications of the sandstone in the material thrown out of an artificial excavation.

Passing southward from this point, along the western side of the county, the next exposures of the Coal Measures is on the south side of sandy creek, in the western part of section 16, township 14,

range 11, on the land of Mr. S. Cannon. The outcrop is only of limited extent, and consists of light-colored, rather argillaceous shale, overlaid by sandstone. The vertical thickness of the shale is altogether, perhaps, four feet. The sandstone was only seen in tumbling masses, with, at one point, a glimpse of the rock in place. No fossils were collected in this locality.

Proceeding up the ravine of sandy creek, in the bottom of one of the side ravines opening from the northward, in the northwest quarter of section 11, township 14, range 11, I observed a large tumbling mass of light-colored, brittle limestone, which evidently had not been far removed from its original bed. Similar masses occur in one or two of the side ravines of this stream and its tributaries in this vicinity, but no good outcrop of beds in place occur along this part of its course. In the western half of section 9, township 14, range 10, there are exposures of light-colored fossiliferous limestone, which has been quarried in several places on the bluffs on the south side of the creek. Underneath this limestone, at one or two points, a little west of the centre of the section, appear exposures of a light-colored shale, apparently entirely destitute of fossil remains. The whole exposed thickness of the shale is about ten feet; that of the limestone is not so easily ascertained, as the exposures are not continuous, and the whole thickness is not exposed at any one place. Judging, however, from the difference of level in the different exposures, it would seem to be not less than that of the shale, and probably much more.

A litle farther up stream, near the center of the section, at the crossing of the railroad (St. Louis, Jacksonville and Chicago), a shaft has been sunk about half way up the side of the bluff. It penetrates the Drift and underlying beds to the depth of about eighty feet, and afforded the following section, according to the statement of parties present during the excavation:

	Ft.	In.
1. Surface soil and Drift clay	22	
2. Light-colored shale	52	
3. Limestone, containing *Hemipronites crassus, Petalodus destructor*, and a few other fossils	0	10
4. Black slate, containing *Aviculopecten rectilaterarius, Cardinia*, and impressions of plants	1	6
5. Coal	3	
6. Fire-clay	8	8
7. Buff or yellowish close-grained limestone, with a slightly conchoidal fracture	3	

No. 2 of this section is probably the shale which has been mentioned as outcropping along the stream below this point.

No prominent exposures of rock occur on any of the tributaries of Sandy creek lying to the southward. The nearest point where

they appear is on the left bank of Coal creek, in the northwest corner of section 16, township 14, range 10, where a foot or two in thickness of a light-colored calcareous shale, or shaly limestone, has been laid bare by the wash of the stream, in the overhanging bank. The same occurs at several points below, along the stream, and at one place, in the northwestern part of section 29, I obtained a few fossils, *Spirifer cameratus*, *Athyris subtilita*, *Chonetes mesoloba*, *Productus longispinus*, etc. A little farther down stream, near the center of the south part of section 30, is Fuller's coal bank, at which locality I took the following section:

	Feet.
1. Light-grayish limestone, containing a few fossils, mostly the same as those mentioned above	15
2. Argillaceous shale	2
3. Coal No. 3?	4
4. Fire-clay, passing downwards into nodular argillaceous limestone	5
5. Argillaceous and arenaceous shales	4
6. Clay, containing nodules of bituminous limestone, exposed	4

This section was made up along a line of exposure of more than one hundred yards in length, and the thickness of the different beds are an average, and not exact measurements taken at one point only. The coal ranges in thickness from three feet eight inches to four feet, and is overlaid at one or two points with decomposing black slate. Perhaps this is generally the case, but the exposures do not show it well. The limestone No. 1 is well exposed, and the seam of coal has been slightly worked by stripping in one of the side ravines a little distance below the main coal banks, and the limestone here affords the same fossils as were mentioned before, together with many large *Productus punctatus*, *P. scabriculus*.

Following down the stream, below the coal bank, we find a reddish shaly sandstone exposed in its bed which, at a point about a mile below, forms a perpendicular bank ten feet high. Similar exposures of the same light-reddish or brown sandstone occur here and there along the creek to the county line, and below, into Greene county.

In the village of Murrayville and its immediate vicinity, two or three borings have been made, in two of which coal is reported to have been met, at depths of one hundred and seven and one hundred and twenty feet. This coal was reported as overlaid by sandstone and black slate; but in neither case did the boring penetrate the coal more than twenty-three inches. It may possibly be the same seam as that which is worked on Coal creek, and which I have referred with doubt to No. 3 of the general section, or, possibly, another higher vein; the known facts are, however, not sufficient to decide the question with certainty.

The principal natural exposures of the Coal Measures in this county, which remain to be mentioned, are those on the main Apple creek and its principal tributaries. The greater portion of the eastern and northeastern townships of Morgan county are upland prairie, where all the older formations are deeply buried under the heavy accumulations of Drift, and where none of the streams which here take their rise have cut down through these Quaternary deposits to any considerable extent.

In the northeast quarter of section 18, township 13, range 8, on the north fork of Apple creek, I observed an exposure in the side of the bluff of about twenty-five feet in vertical height, the upper twenty feet of which is an arenaceous shale, and the remaining lower portion consists of one or two thin beds of limestone, with black carbonaceous shale and fire-clay, and, in some places, one or two inches of coal between the dark-colored shale and the fire-clay. The limestone afforded a few fossils, chiefly of one or two species of *Bellerophon* and *Cyathoxonia*. These lower beds may be traced along the banks of the creek for about half a mile, although the exposure is not continuous, and then, the dip of the strata being apparently a little greater than the fall of the stream, and in the same direction (about southwest), it finally disappeared beneath its bed. A little below where these beds disappear, I observed, in one of the side ravines running down from the northward, heavy exposures of a massive brownish or reddish sandstone, having, probably, a total thickness of over thirty feet. A similar sandstone is said to occur some two miles above this point on the creek, but it escaped my observation while examining this region. This sandstone contained a few impressions of plants, generally very imperfectly preserved, but no other fossils were obtained.

Continuing down the ravine of the creek about half a mile farther, I observed a place where there had apparently been limestone quarried, though the ledges were not visible at the time of my visit. From the appearance of the fragments, I judged it to be an irregularly-bedded light-grayish fossiliferous rock, somewhat resembling the limestone outcropping along Sandy creek, which has been described on a preceding page. Below this exposure, outcroppings of the older rocks are not frequent along this fork of Apple creek, until we approach its junction with the main creek. About half a mile above the junction, in the northeast corner of section 34, township 13, range 9, I observed a foot or two in thickness of argillaceous shale, with about eight inches of impure shaly limestone appearing in the bank of the creek, just above the water. Below the forks of

the creek, as far as to the county line, a bed of hard bluish limestone appears at the water's edge, and at a few points it may be seen that this is overlaid by argillaceous shales. Passing up a small branch, which comes down from the northwestward and enters the creek bottom near the county line, I observed at one point, in the northwest quarter of section 34, on the land of a Mr. Hart, a place where a coal seam had been worked by stripping, though I was unable to see the coal itself or to note its surroundings. A little farther up the ravine, I observed exposures of a shale with thin beds of limestone, and over all a massive grayish sandstone and sandy shale. Passing up the east fork of Apple creek, above the junction, we find the continuation of the exposures of the hard bluish limestone before mentioned, appearing along the banks of the stream for a mile or more, sometimes in place, and sometimes in large tumbling masses in the bed of the creek. It also appears in some of the side ravines, and has been somewhat quarried at one place on the land of Mr. Benjamin Taylor, in the southwest quarter of section 31, township 13, range 8, at a distance of half or three-quarters of a mile from the creek. About a quarter of a mile above the Sperry bridge, in the northwest quarter of section 31, township 13, range 8, a section, made up from about one hundred yards' exposure along the banks, was as follows:

	Ft.	In.	Ft.	In.
1. Limestone	2			
2. Bluish and dark colored argillaceous shales	12			
3. Black slate	2			
4. Coal	1	3 to	1	6
5. Clay, containing calcareous nodules	6	to	8	
6. Shale, only visible in the bed of the stream.				

No fossils were obtained from any of the strata, except the limestone, which afforded a few imperfectly preserved specimens of *Productus punctatus*, *P. semi-reticulatus*, and *Athyris subtilita*. This limestone is probably the same as that observed farther down stream, as it is identical with it in appearance and thickness. Still farther up stream it appears still higher in the side of the bluffs, and has been considerably quarried; and a little above this point it disappears entirely, and is seen no more along the stream.

Up a small branch which enters Apple creek from the southwest, near the centre of the south line of section 27, I observed outcrops of shale, limestone, etc., with a small seam of coal, in the following order:

	Feet.
1. Light-colored, fossiliferous limestone	1
2. Clay shale	3
3. Black or dark-colored shale or slate	10

	Feet.
4. Light-colored shale	8
5. Coal	1
6. Fire-clay, exposed	4

In one or two places I observed an exposure of a few inches of shale in position above No, 1 of this section, but not in contact. The fossils in the limestone were generally imperfect and indistinct. In the shales below they are easily obtained, and tolerably well preserved. The most abundant species observed were corals of the genus *Cyathoxonia, Leda Ventricosa, Astartella varica, Pleurotomaria Grayvillensis* (?), and *Orthoceras*, etc. A little below the point at which the foregoing section was taken there is a continuous ledge of the shale, from five to eight feet in height, extending along the bank of the river for a distance of twenty or thirty rods. Still farther up the ravine, in the northeast quarter of section 34, the coal again outcrops, and still above this, near the Macoupin county line, in the southwest quarter of section 35, there is an exposure of ten or fifteen feet of shale overlying the thin limestone (No. 1) of the above section.

North of these exposures, in the eastern part of the county, there are but one or two points where the older rocks appear above the surface, or are artificially exposed. One of these occurs on the land of Mr. John Rohrer, in the northeast quarter of section 25, township 13, range 8, where a reddish sandstone, in layers varying from two inches to a foot in thickness, has been quarried as a building stone. The stone occurs in the bed of a small branch, running north into Apple creek, and four or five feet of gravel has to be removed before reaching the valuable portions of the rock. To the northward of this, in the vicinity of Waverly, sandstone is said to have been met with in digging wells, at a depth of sixteen or eighteen feet—possibly the same beds that are exposed at this point.

Near Prentice station, on the St. Louis, Jacksonville and Chicago railroad, in the northeast corner of the county, a shaft has been sunk in the beds of the Coal Measures and the overlying Drift, to the depth of about two hundred feet or more. As this affords the only means we have of judging of the Coal Measures in this part of the county, it will, perhaps, be as well to give the section of the beds passed through, in full, as reported to me. After eighty-five feet of Drift, the variations of which have been already given in a previous portion of this chapter, the order of the strata was as follows:

	Feet.	In.
1. Rotten black slate	2	6
2. Coal	0	

		Feet.	In.
3.	Fire-clay	12	4
4.	Shale	1	0
5.	Coal	0	2
6.	Fire-clay	1	3
7.	Sandstone and shale	16	7
8.	Shale, with bands of ironstone	56	0
9.	Black slate (fossiliferous)	3	10
10.	Soft sandstone	15	0
11.	Shale	14	0
12.	Limestone	1	0
13.	Slate	2	0
14.	Coal	2	10
15.	Fire-clay	6	0

Ninety-two feet below the lowest coal in this section another two-inch seam of coal was reported by the borers, the intervening strata below the fire-clay being argillaceous limestone six feet, and eighty feet of shale. If the lower coal in the shaft is No. 4 of the Illinois river section, as given by Prof. WORTHEN, as seems quite probable, it would indicate a remarkable thinning out of all the coal seams in this particular region, and a considerable local variation in all the strata at this point.

The only point which remains to be mentioned, in Morgan county, as a locality where the beds of the Coal Measures have been penetrated, is at the city of Jacksonville, where a bed of coal thirty inches in thickness is reported to have been struck by a boring made on the grounds of the Insane Asylum, at the depth of one hundred and ninety feet. Another boring, which was made near the track of the Toledo, Wabash and Western railroad, just without the eastern city limits, is reported to have struck coal at very nearly the same depth, but with the remarkable thickness, according to a journal of the boring, which was kindly furnished by the proprietors, Messrs. Davenport & Berry, of eighteen feet. This, it seems probable, is a mistake; but the shaft which was being sunk at this place at the time of my visit (Nov. 30, 1868) had not penetrated the Drift, which here is over one hundred and forty feet in thickness, and no more reliable data could be obtained.*

*Since this report was made, a section of the Jacksonville shaft has been obtained from Messrs. Davenport & Berry, and is as follows:

	Feet.	In.
Drift, clay and gravel	142	0
Quick-sand	10	0
Hard, green sand, with a trace of coal	2	0
Soapstone (clay shale)	14	0
Sandstone	3	9
Gray, sandy shale	12	0
Clay shale, with iron bands	6	0

—Continued at foot of next page.

St. Louis Limestone.—The outcrops of this formation are confined to the base of the bluffs, along the eastern edge of the Illinois bottoms in this county. In lithological characters, it is also rather variable, consisting of reddish and light-colored sandstones, and a hard, impure, reddish, calcareous rock, which appears in one or two places. It nowhere presents such a development as may be met with farther south, and disappears entirely before reaching the northern limits of the county. The most northern exposure observed was in the southwest corner of section 19, township 16, range 12, on the land of Mr. Chamberlain, where I observed a light-gray limestone on the sides of the bluff road, and, a little higher up on the sides of the bluff, large tumbling masses of a light-colored sandstone. About a quarter of a mile below this point, ledges of a reddish, splintering, calcareous sand-rock, appear in the side of the bluffs, and have been somewhat quarried.

Passing still further to the south and west, along the bluff road, we see at various points a light-reddish shaly sandstone, appearing in the ditches alongside of the road, and in the bottoms of some of the small ravines, which come down through the bluffs. Mention has already been made, in the earlier part of this chapter, of a reddish sandstone occurring in heavy ledges up in the ravines of Coon run, which may, possibly, belong to this formation, but more probably to the Coal Measures. About half a mile north of the southern line of the county, in the western part of section 36, there is a small quarry on the edge of the bottom, in a rather coarser-grained light-colored sandstone, which has been excavated to the depth of about four feet. In none of the exposures of the rocks of this age in Morgan county were any good fossils obtained, but ledges of rock containing some of the characteristic fossils of this group, in tolerable abundance, occur a short distance over the boundary, in Scott county.

	Feet.	In.
Conglomerate	2	6
Gray shale	14	0
Limestone	0	6
Black shale, with concretions of septaria	4	0
Coal	3	0
Fire-clay, not passed through	1	6

The fire-clay passes downward into a very hard, arenaceous rock, filled with Stigmaria. The slaty, black shale of the roof contains *Lingula umbonata, Discina nitida, Aviculopecten rectilaterarius*, and *Monotis* (?) *gregaria*. The concretions of septaria are veined with selenite. From the appearance of the coal and the beds with which it is associated, I am inclined to regard it as probably the equivalent of coal No. 3 of the section in Fulton county.

A. H. W.

Economical Geology.

Coal.—As will be seen by the foregoing pages, at least four or five different beds of coal appear in the surface outcrops and artificial excavations of this county, several of which have been more or less extensively mined. In fact, the whole surface of the county, excepting the Illinois bottoms, and a small area immediately adjoining, is probably underlaid by one or more seams of coal. The lowest of these, the No. 1, or Exeter coal, has been mined to some extent along the river bluffs, near the northern border of the county, where the seam is about two and a half feet thick. It is, also, probably, the seam that is worked at McPherson's, and on Indian creek in section 4, township 16, range 11, but beyond these points I have not identified it in any exposures within the limits of the county. Although the coal of this seam is of a good quality, yet it is not generally of sufficient thickness to be profitably mined, except along the natural outcrops, or where it is only of comparatively insignificant depth below the surface.

The next seam above this, the Neeleyville coal, is rather extensively worked at that place. The seam here is about four feet thick, and only twelve or fourteen feet below the surface at the principal diggings along the railroad. As, however, it has no good natural roof, but is overlaid immediately by the clays of the Drift, from six to twelve inches of coal has to be left for a roof, and much trouble and expense must be incurred in cribbing. The coal is of good quality, and is much used on the Toledo, Wabash and Western railway, and is also sent elsewhere to market.

The four foot seam, which outcrops along Coal creek, in section 30, township 13, range 10, and which I have referred, with doubt, to No. 3 of the general section, has been mined to some extent, but the works have been abandoned. This bed contains some pyrites, disseminated throughout the mass, but, when sufficiently free from this material, the coal is reported to be of a very good quality.

The other seams of coal which are worked at all in this county, probably belong to the middle and upper Coal Measures, and as far as they have been opened, are generally of comparatively slight thickness. It would seem probable, however, considering these beds to belong to the upper or middle parts of the formation, that other and heavier seams of coal may be met with at greater depth beneath the surface. All the borings which have been made in the central part of the county seem to confirm this, as far as they go. The

small vein outcropping along Apple creek, in the southeastern part of the county, is not easy to place in the general section. It probably is, also, in the middle portion of the series, if not higher. The thickness is too slight to admit of its being profitably worked, except by stripping, etc., along its outcrop.

Clays.—Some of the underclays of the different coal seams in this county will probably furnish a good material for fire-bricks, tile, or pottery. The clay beds under the different coal seams, however, generally appear at the surface only along the sides of high bluffs, or in the bottoms of deep ravines, and have not been as yet turned to economical account. Good clays for ordinary brick-making are found in the beds of the Drift, under the surface-soil in all parts of the county.

Building Materials.—The sandstone over Coal No. 1, in the northwestern part of this county, has been worked to some extent as a building stone, and in some instances appears to answer the purpose well, and when a proper selection is made of this material, it appears durable. The stone abutments of a bridge over Indian creek, at Arenzville, just over the line in Cass county, which were built for the proposed Rock Island and St. Louis railroad, are of this sandstone, quarried within the limits of Morgan county, and after ten years exposure, appear as whole and sharply cut as when first laid. In some parts of these beds, however, the rock seems to crumble on weathering, and should, therefore, be rejected as a building stone.

The sandstone worked on Willow Branch, in section 19, township 15, range 11, is probably near the same geological horizon. It is very similar in appearance, being a light-brown or gray sandstone, weathering, however, to a rather lighter color than that from the previously mentioned localities. It is, as has been said before, quite soft and easily worked when first quarried, but is said to harden on exposure.

The limestone beds of the Coal Measures, and their use as a building material, have been briefly noticed in the preceding pages. Their use has been mainly local and limited, and from the restricted nature of the exposures in the sides of high bluffs or bottoms of ravines, and the general inconsiderable thickness of the strata, it seems probable that it could not well be otherwise. The sandstone beds of the Coal Measures, when sufficiently resistant to atmospheric influences, are likely to afford the principal home-supply of building material in this county. The sandstones, etc., of the St. Louis group, which outcrop in this county, have also been used to some extent,

but no such quarries as are found in this group in the adjoining counties, have as yet been opened in Morgan county.

Some of the limestone beds in this county appear suitable for the manufacture of quick-lime. Most of this article, however, is derived elsewhere, and I am not aware that this manufacture has been carried on to any extent in any place in the county. Sand and gravel for building purposes are sufficiently abundant in all parts.

CHAPTER XXI.

CASS AND MENARD COUNTIES.

The two counties of Cass and Menard, which are described in this chapter, are situated contiguous to each other in the western central portion of the State. Cass county, the largest of the two, is bounded on the north by Mason county, on the east by Menard county, on the south by Morgan county, and on the west by the Illinois river. The remaining boundaries of Menard county are Mason and Logan counties on the north and east, and Sangamon county on the south. The superficial area of Cass county is about four hundred and sixty square miles; of Menard county about three hundred and eleven; thus forming an aggregate area for the whole district of about seven hundred and seventy-one square miles, or very nearly twenty-one and a half townships.

The surface of the country is, for the most part, gently undulating, becoming hilly and broken only along the courses of the streams. In the western part of Cass county, along the Illinois river, there is a strip of bottom land, varying in width from three and one-half to five miles. This extends also along the Sangamon river on the northern border, and through the eastern part of this district, gradually, however, becoming more narrow and interrupted until, through the greater part of Menard county, the bottoms are seldom more than half a mile broad.

The soil of the prairie portion of these counties is the same as that in the whole of this portion of the State, a dark-colored loam with a lighter colored clay subsoil. On the ridges and bluffs which skirt the streams we find this subsoil everywhere, except upon the Loess formation, exposed at the surface of the ground, and generally bearing a heavy growth of timber. On the bottom lands the soil is an alluvial arenaceous loam, and, excepting in localities where the sand too greatly predominates, is an excellent and productive soil. The principal kinds of

timber upon the uplands are the common varieties of oak and hickory, with elm, sugar maple, black and white walnut, linden and various other species which are rather less frequent. On the bottoms we find willow, ash, sycamore, cottonwood, etc., in addition to some of the beforementioned species, forming a considerable proportion of the timber. The proportion of prairie to wooded land in the whole district is probably nearly two to one.

The geological formations in this district consist of the Quaternary deposits, the Loess and Drift, and the Coal Measures, which alone of the older formation underlie the surface beds of clay, gravel, etc., in these counties. The Loess forms the bluffs along the Illinois and Sangamon bottoms, in Cass county, and also appears in the bluffs of the Sangamon river, and Salt creek, to some extent, in Menard county, though it does not appear as prominently in the landscape as farther west. Its general features here are the same as in the other river counties, and it forms the same bald bluffs that are seen in other localities along the Illinois and Mississippi rivers. The material here is an ash or buff-colored marly sand, containing fossil fresh-water shells of existing species. The thickness of the formation is considerable, some sixty or seventy feet immediately at the bluffs, but it rapidly thins out in the back country, in many places disappearing entirely within a very short distance. It appears to extend the farthest inland along the Sangamon river in Cass county, north of the town of Virginia, and several good sections of this deposit may be seen in the cuts on the Peoria, Pekin and Jacksonville Railroad, between that place and Chandlerville. Along the upper course of the Sangamon, in Menard county, this formation is scarcely to be seen at any point, and may perhaps be said to cease entirely along this stream, within the limits of the county.

The Drift deposits in this district consist of brown, yellow and blue clays, with boulders, while sand and gravel seams are of frequent occurrence amid the mass. The thickness will probably range, over the whole district, between forty and one hundred feet; of this, only an estimate can be made in most cases, as shafts and wells of sufficient depth, and other opportunities of obtaining any exact knowledge in regard to this particular, are rarely met with over a greater portion of this region. At Sweetwater, in Menard county, it was found to be one hundred and ten feet from the surface to the uppermost bed of rock, and the boring presented the following section:

	Feet.
1. Surface soil and brown clay	40
2. Quicksand	11
3. Blue clay	59

In the eastern part of section 2, township 17, range 6, near the village of Athens, a shaft commenced at the bottom of a ravine which cuts down some forty or fifty feet below the general level of the country, was sunk eighty-six feet without striking a bed of rock, and at the depth of sixty-five feet pieces of coniferous wood, in a tolerable state of preservation, were taken out. Many large boulders, which had to be removed by blasting, were also met with, some of them of granite, indicating by their material a remote northern origin, but more were fragments of the underlying Coal Measure limestone and sandstone, containing many of their characteristic fossils, and showing, by their comparatively angular outlines and unworn surfaces, evidences that they have not been transported far from their original beds. Some of these latter, near the mouth of the shaft, are of such size and in such positions as to appear like a natural outcrop of the Coal Measure rocks, and might perhaps be taken for such, were it not for the incontestible proof to the contrary afforded by the rocks themselves. Throughout the western portion of this district good sections of this formation are rarely met with, and accurate information as to its details cannot be obtained. Its thickness, however, may be put down approximately as at least averaging sixty or seventy feet over the greater part of this region.

Coal Measures.—This formation, as developed in this district, comprises a thickness of over three hundred feet of the middle and lower portion of the series, and contains two or three seams of coal of workable thickness. The best development appears to be to the eastward, the westernmost exposures being also the lowest in stratigraphical position, and the higher beds appearing as we travel east. The principal exposures, commencing with the lowest, are as follows:

In the southwest part of section 21, township 18, range 11, where the road between Virginia and Beardstown comes down through the bluffs to the bottom lands along the Illinois river, there are several old coal shafts, only one of which (Mr. Kinney's) is now worked. This is reported to have afforded the following section:

	Feet.
1. Soil (Loess)	15
2. Brownish sandstone, containing many vegetable impressions	13
3. Limestones ("Blue rock")	2
4. Clay shale ("Soapstone")	12
5. Coal (No. 1 of Illinois river section)	3
6. Fire-clay, very hard	4

No. 2 of this section crops out along the bluff road, at the edge of the bluffs, and a few rods farther west, in ledges several feet in vertical exposure. It is a soft micaceous sandstone of a light-brown

or whitish-brown color, and appears slightly crumbling at this locality. About a quarter of a mile farther north the coal seam No. 4 is reported to have been reached by digging in at the foot of the bluff and worked by stripping. Still farther to the northward, in the northwest quarter of the same section, I noticed in an old quarry on the side of the bluff, a little to the right of the wagon road, an exposure of about ten feet in thickness, of a heavy-bedded sandstone, the same as that which is met with in the shaft, and exposed on the road-side near by. A little farther northeast, near the eastern line of section 16, the coal seam is said to appear again, and to have been worked to a slight extent in the side of a ravine about half a mile from the road.

Above the north line of section 21 the bluffs, for about two miles, are mostly of Loess, and it is necessary to go up the side ravines in order to see the exposures of rock. About half a mile up the large ravine, which cuts through the bluffs in the southern part of section 10, I observed on the eastern side another exposure of the sandstone (No. 2 of the section), and a little above this, near the northwest corner of section 14, I also noticed about ten feet exposed of the shales No. 4, capped by a single layer of limestone two feet thick, (No. 3). The coal seam must be very near the bottom of the ravine at this point, but it is not exposed. The outcrops of the sandstone continue up this ravine and its branches in the eastern part of section 14 and the western part of section 15, for about three-quarters of a mile above this point, and then disappear entirely. The rock is, in most respects, the same as in the localities before described, a soft, even-textured sandstone, varying in color from brownish-red to a dirty-white, and in some portions having a light bluish tinge and a slightly variegated appearance. It contains a great abundance of fossil vegetable remains, calamites, etc., but from the nature of the rock very few are found in a good state of preservation.

From the mouth of this ravine, for a short distance to the northeast, along the face of the bluffs, there are no very good exposures of any of the beds. There seems to be here, however, a low anticlinal, the strata having gradually risen, until, at this point, the coal seam No. 4 has been worked by drifting into the side of the the bluff almost midway between the base and summit. The crown of the arch is very near this point, and the direction of the axis of the fold must be, judging from appearances, about southeast. The seam of coal is said to be about three feet thick at this point, but

at present only the entrances to the old drifts and the debris can be seen, no work having been done here for a number of years.

A short distance further along the bluff road, nearly on the line between sections 10 and 11, another large ravine opens out, and the rock again appears. The coal seam was formerly worked also at this point, at a level some fifteen or twenty feet above the road, though its outcrop is not now visible. Just below the level of the old drift I observed an outcrop of what appeared to be a nodular argillaceous limestone, which I take to be just underlying the fire-clay.

Above the opening of the drift the shale No. 4 appears, and still higher up the bank the limestone No. 3 has been slightly quarried, and above all the sandstone No. 2 appears, but at present the debris of the sandstone and shale covers all the lines of junction, and no very reliable measurements of the thickness of the beds can be taken. The sandstone continues to appear in the sides of the ravine, and in the bed of the small stream which occupies it for upwards of half a mile. Its total thickness, although in no place so fully exposed as to afford an opportunity for accurate measurement, can hardly be less than fifty or sixty feet.

East of the mouth of this ravine, through the northern half of section 11, this sandstone appears in ledges in the bluffs, at an elevation of fifty feet or more above the road, and has been quarried in one or two small ravines. In one of these ravines, in the northeast quarter of section 11, I observed the only outcrop I was enabled to find of the coal seam, the exposed thickness of which was about three feet. This is on the northeastern slope of the anticlinal, and only a little farther on the Loess and Alluvium come down to the road, and the exposures of rock cease to appear for the distance of several miles. Leaving the last mentioned localities, and continuing eastward along the base of the bluffs, the next prominent exposure is met with near the center of the western part of section 10, township 18, range 10, on the left bank of Job creek, just above the point where it comes out of the bluffs and enters the bottoms. Here the sandstone No. 2 has been quarried in the hillside, some thirty feet or more above the water, and presents precisely the same appearance as at the other localities already mentioned. The lower beds of limestone and shale, and the coal seams, if, indeed, they occur above the bottom of the ravine at all. are completely hidden by the fragments and debris from above, The sandstone appears again at one or two points farther east, within the distance of one mile, in the northeast quarter of section 10, and almost on the line between sections 10 and 11.

The only remaining locality in Cass county, where the older rocks appear at the surface, or are artificially exposed, is on Panther creek, near Chandlerville, in sections 5 and 6, township 18, range 9. A shallow coal shaft in the southeast quarter of section 6 afforded the following section, according to Mr. William Shores, the proprietor:

		Feet.	In.
1.	Surface soil	4	
2.	Gravel (blue bind)	4	
3.	Black slate	2	
4.	Clay shale (soapstone)	13	
5.	Coal	2	6
6.	Fire-clay, passing downwards into nodular limestone	2	
7.	Clay, penetrated	2	

The shale and slate appear in the bank of the creek for upwards of half a mile above the coal diggings, seldom rising more than two or three feet above the water's edge. No fossils were discovered. It seems quite probable that this seam of coal is the same as that in the exposures further west, although from the lack of continuity in the exposures, and of other sufficient evidence, it may, perhaps, be best to refer it only provisionally.

In Menard county, the eastern portion of this district, we find exposed only the middle bed of the Coal Measures, no rocks lower than the under clays of the coal No. 4 of the Illinois General Section having been identified. The following section shows the order of superposition and comparative thickness of the different beds in this region:

		Feet.
1.	Limestone	20 to 30
2.	Argillaceous shales	10 to 15
3.	Coal (No. 7, Ill. R. sect.)	1¼
4.	Fire-clay and shales	18 to 20
5.	Limestone	3 to 4
6.	Coal (No. 6, Ill. R. sect.)	1 inch to 3
7.	Fire-clay	5 to 10
8.	Shales and sandstone	30 to 40
9.	Limestone	1 to 3
10.	Black slate	1 to 4
11.	Coal (No. 5, Ill. R. sect.)	5 to 7
12.	Fire-clay	6 to 8

Of this section, the beds below the coal No. 6 have not been identified in any natural outcrop, and have only been reached by borings and shafts sunk down to the coal No. 5, which is extensively worked at Petersburg and vicinity. The upper and middle beds of coal in the above section were also formerly worked in the vicinity, but since the opening of the lower seam the work has been discontinued, or is only carried on in a desultory way by stripping. The fire-clay under these two beds was not separated from the shale in

all the sections reported to me by other persons, and it is possible that in some cases it may not be developed to any considerable extent.

Just above the village of Petersburg, on the western bank of the Sangamon river, and close to the water's edge, the limestone overlying the middle vein or coal No. 6 appears and has been quarried to a slight extent. It is a rather close-textured, light-drab or gray limestone, weathering buff, and contains a few fossils of the species *Spirifer cameratus*, *Athyris subtilita*, *Athyris Royissii*, *Productus costatus*, *Productus longispinus*, etc. The underlying coal has been worked by stripping, a few rods further down stream, and is, at this point, two or three feet thick. The peculiarity of this seam of coal is its uneven thickness, it being reported sometimes to vary, within short distances, from a thickness of two or three feet to only as many inches, or even less; and from this fact it is generally considered too unreliable to be worked, except by stripping along its surface outcrops. Both the coal and its limestone roof are passed through by Taylor's and Wright's coal shafts, which are sunk from the top of the bank to the lower coal, or No. 5, within a quarter of a mile of this outcrop.

On the opposite side of the river, near the centre of the north line of section 25, township 18, range 7, and about a mile and a half above the town, there appears a ledge of brownish sandstone, which extends along the river bank about two hundred yards, with an elevation above the water of some six or eight feet. This appears to replace the limestone over the middle coal, as it is stated that that seam immediately underlies it, and was at one time worked at this point. The rock appeared massive, or very irregularly-bedded at this point, and seemed to stand exposure well.

The upper bed of coal is not at present worked, but the entrance to the old drifts may be seen in several places along the Sangamon river bluffs, above Petersburg. It does not outcrop near the village, but its position may be told by these marks, and the clay shale which forms its roof appears at one or two points up the ravine, which opens out of the bluffs just above the woolen mills on the southern outskirts of the town, and may be seen, on close examination, at the mouths of some of the drifts. This shale is also exposed in other side ravines farther up the stream, but the beds underlying the coal, and between it and the middle seam, are only exposed at the Salem mills, some two miles above Petersburg, on the west bank of the river. At this place, just above the mill-dam, at the edge of the water, there is an outcrop of the middle coal, overlaid by two

feet or more of shaly bluish limestone, and still above this there is exposed, in the almost perpendicular bank, nine or ten feet of light-colored shales, containing a few thin seams of clay and bands of iron ore. A little farther up the road, and about ten feet higher in actual elevation, the upper coal seam crops out of the bank on the roadside. It is here about sixteen inches in thickness, and this is said to be pretty constantly the same in all places where it has been worked. The thickness of the middle bed could not be well ascertained by personal observation at the time of my visit, but it was stated to me to be two or three feet.

Following up the road south of the mills, the entrances to the disused drifts along the bluffs at the side of the road will show the position of the small seam, though there are no good natural outcrops for some little distance. About half a mile up this road, however, in the northwestern corner of section 36, township 18, range 7, we find it again outcropping in the bed of a dry branch, and a little farther up, the bottom and sides of the branch are composed of the drab and brown, and in some parts nearly black, argillaceous shales which form its roof. This shale contains many concretions of ironstone, generally lenticular in form, and sometimes of considerable size. Still farther up the ravine, at Arnold's quarry, we find above the shale, though the line of junction is nowhere visible, heavy beds of a light-gray or bluish-gray limestone, exposed in the hillsides to the height of some thirty feet or more above the bed of the branch. This limestone is quarried both as a building stone and for the manufacture of lime, and affords many fossils of the species *Spirifer lineatus*, *Spirifer cameratus*, *Athyris subtilita*, *Retzia Mormoni*, *Rhynchonella Osagensis*, *Productus longispinus*, and others. The exposures of both this limestone and the underlying shales are not such as to allow any very exact estimate of their respective thicknesses. The limestone, however, will probably not exceed twenty or thirty feet, and the shale fifteen or twenty feet in total thickness.

On the Sangamon river, above the Salem mills, there are no very good exposures above high water mark, though beds of rock are said to form the bottom of the stream at one or two points. A coal shaft, however, which was sunk on the land of Mr. Sampson, in the southeast quarter of section 32, township 18, range 6, affords a section of all the beds, from the top of the upper seam of coal to the under clay of the lower and largest bed. The total depth of the shaft is a little over ninety feet, and the strata were passed through in the folowing order, as reported to me:

		Feet.	In.
1.	Surface soil and clay	14	
2.	Black slate or shale	1	
3.	Coal	1	3
4.	Fire-clay and shale	17	3
5.	Hard limestone	4	
6.	Coal	2	6
7.	Fire-clay and shale (very hard)	39	
8.	Black slate	1	
9.	Coal	6	4
10.	Fire-clay penetrated in sump	5	

It will be observed that in this section the limestone which generally is found just above the roof slate of the lower coal, is missing. This, however, is probably only a local peculiarity.

Another point along the bluffs of the Sangamon, where rock is said to occur, is in the northwestern part of section 15, township 17, range 6, on the land of Mr. A. Hale, where it is stated that limestone was quarried out in former times. I visited the excavation, but the rock was not visible above the rubbish, and judging from the chips, I made out the rock to be the same in appearance and fossils as that in Arnold's quarry, near Salem. The only doubt is, whether this may not have been merely a large detached mass, imbedded in Drift, like many in this vicinity.

In the northeast quarter of section 19, township 18, range 5, on he head-waters of Indian creek, there appears in the banks and beds of the stream, for about two hundred yards, a bed of light-colored, nearly white limestone,. which seems to be almost entirely made up of crinoidal stems, no other fossils being observed. Half a mile or more below this, on the land of Mr. T. Kincaid, in the northeast quarter of section 24, township 18, range 6, the limestone again appears, and has been quarried to the depth of about seven feet. It is here somewhat different, the upper five feet in the quarry being of a grayish, heavily-bedded limestone, containing very few fossils. A section of the quarry would be nearly as follows:

		Feet.	In.
1.	Heavily-bedded gray limestone	5	0
2.	Dark-colored, somewhat shaly beds	1	6
3.	Dark-colored argillaceous shale, containing *Hemipronites crassus*, etc.	0	6
4.	Hard, pyritous band, with a trace of coal	0	1½
5.	Whitish fire-clay, only penetrated	0	8

Numbers 4 and 5 of this section are not to be seen in this quarry without special excavation, and numbers 1 and 2 appear to graduate into each other at some points.

Below this, for about a quarter of a mile, the limestone is met with by digging into the banks, and outcrops at one point in the side of the branch, about one hundred and fifty yards below teh

quarry. The rock there is somewhat different from that before described, being a very light-colored, nearly white, thinly and irregularly bedded limestone, containing *Spirifer lineatus*, *Athyris subtilita*, and a few other species, in considerable abundance.

The remaining exposures in the southern part of Menard county occur in the southern parts of sections 13, 14 and 15, township 17, range 7, along the banks of Rock creek. The easternmost of these occurs in the southeast corner of section 13, a little west of the Springfield road, where a thickness of a few feet of light-colored shale appears in a field on the bank of the creek. About three-fourths of a mile above this on the stream, and nearly due west, we come to the first of the limestone quarries, which continue to appear at intervals for upwards of a mile above this along the creek. The stone which is quarried here is a gray or bluish-gray fossiliferous limestone, occurring in rather heavy beds in the bed of the creek and in the sides of the bluffs along its course. In one or two places I noticed from one to two or three feet of brownish shaly sandstone immediately above and resting upon the limestone. It seems to me probable that this limestone may be identical with that at Arnold's quarry, near Salem, and in that case it will probably be found to underlie the Drift deposits over a considerable area in the southern part of Menard county. Its thickness at this point could not be well ascertained, as at no one point is there exposed more than a few feet; but, from the difference of level of the different outcrops and workings, the beds being apparently horizontal, or nearly so, I should judge that it is not less here than at Arnold's —at least twenty feet, and perhaps more.

North of Petersburg, in Menard county, there are comparatively few outcrops, or artificial exposures, borings, etc. At the eastern extremity of the wagon-bridge over the Sangamon, near the brewery, there is a slight exposure of shales, and the small upper (16-inch) seam has been somewhat worked in former times; and in the hillside a little distance to the north of this point I observed many large boulders or fragments of Coal Measure limestone, which may perhaps indicate the presence in the body of the bluff of the heavy limestone beds which occur above this coal farther to the south.

Fischer's coal mine is situated on the railroad, nearly two miles north of the village of Petersburg, and nearly at the base of the river bluffs. The following is the section afforded by the main shaft:

	Feet.	In.
1. Surface soil and Drift clay	46	0
2. Shale	14	0
3. Hard, dark-colored limestone	0	4
4. Black slate	2	0
5. Coal No. 5	6	0
6. Fire-clay and shale	8	0

The hard limestone, No. 3 of this section, lies very irregularly upon the dark slate; its average thickness, however, is in this shaft not more than stated above. *Discina nitida*, and one or two other of the species most common in the roof-slate of the coal, occur also in this limestone, though less abundantly. A shaft which was sunk by Captain Taylor, near the railroad station, about three-quarters of a mile farther south, passed through the same beds, but, as this shaft commenced higher up on the hillside, some thirty-five feet of shale was penetrated, and the limestone and slate were rather better developed. The coal No. 6 would doubless be met with in a shaft sunk from the top of the hill, and perhaps the small upper vein also.

On the eastern bank of the Sangamon, in the center of the eastern part of section 1, township 18, range 7, and about half a mile above the railroad bridge, I observed an exposure of a reddish-brown shaly sandstone, extending about two hundred yards along the river bank, and rising to a height of seven or eight feet above low-water mark. The rock is precisely similar in appearance to that in a similar exposure on the river bank above Petersburg, which has been described on a preceding page, and which was then said to overlie the coal No. 6. If it is identical with that, it will show a dip of at least twenty or thirty feet to the northward, between Fischer's and this place, a distance of rather less than a mile. A similar sandstone is said to have been quarried in former times, by the early settlers, in the northwest quarter of section 36, township 19, range 7, on the edge of the river bottom, at the base of the bluffs. At present no rock in place is visible, but the scattered fragments or quarry chips are identical in appearance with the rock in section 1, township 18.

The boring at Sweetwater penetrated to the depth of one hundred and seventy-five feet. After one hundred and ten feet of Drift and surface deposits, the order and thickness of the different beds was reported as follows:

	Feet.
1. Hard limestone	2
2. Pipe-clay	10
3. Shale ("soapstone")	40
4. Limestone	3

		Feet.
5.	Black slate	5
6.	Coal	5
7.	Fire-clay, not penetrated more than a few inches.	

The coal in this section is doubtless No. 5 of the general section, which will probably be found to underlie the greater part of the northern portion of Menard county. No. 6 had probably dwindled in thickness until it was not detected in the boring, as its proper place would be between 1 and 2 of the above section. This boring affords almost the only means of ascertaining with any degree of accuracy the lay of the strata in the more northern parts of Menard county. There remains only two or three isolated localities where the beds of the older rocks have been met with in artificial excavations, and in these instances the facts necessary to enable one to form a correct judgment are wanting. Near the center of the south line of section 12, township 19, range 7, a bed of yellowish sandstone is said to have been once uncovered in the side of the river bluffs. This is immediately overlaid by a siliceous conglomerate, which I am not disposed to consider older than the Drift, and the sandstone may very possibly be of the same age. Near the base of the bluffs, not far from this point, I heard it reported that a small sixteen-inch seam of coal had once been found, but is not now visible. Other localities where coal is stated to have been found are at the foot of the bluffs of the Sangamon, near the center of section 3, township 19, range 7, and on Clary's creek, near the center of the south line of section 27, township 19, range 8. In neither of these localities were the beds visible, nor could any satisfactory information be obtained.

Economical Geology.

Coal.—As has been stated in the foregoing pages, all parts of this district appear to be underlaid by the Coal Measures, which here include the horizon of four or five different seams of coal. It seems highly probable, indeed, that there is no portion of the district, excepting the bottom lands along the Illinois and Sangamon rivers, in the western part, that is not underlaid by at least one coal bed of workable thickness. The lowest of these seams which is exposed or worked anywhere in this region is probably the Coal No. 1 of the general section of the State, identical with the Exeter coal of Scott county, although it is possible that it may prove to be No. 2 of the general section, or the same as the Neeleyville coal in Morgan

county. The absence of black slate in the roof and the great thickness of the sandstone above, are facts which seem to slightly favor this view, but are, however, not conclusive. The absence of exposures in the southwestern portion of Cass county is to be regretted as not affording the means of positively determining this question.

This seam of coal is now actively worked at only one or two points in Cass county, although it was formerly much more extensively mined along its outcrop on the side of the bluffs of the Illinois and Sangamon rivers. The seam will average three feet in thickness, and is reported to be of fair quality. The discontinuance of the most of the mining operations was mainly due to the small local demand and the competition of other mines in the adjoining counties on the Illinois river.

In the eastern portion of this district the lowest seam worked is No. 5 of the general section, which will average in the different shafts and borings from five to seven feet in thickness. Along the Sangamon river bottoms, at Petersburg and above, it has been met with in depths varying from seventy to eighty feet. On the upland portions of the county it has been reached but once, by a boring at the depth of one hundred and seventy feet. This bed has everywhere a good roof of limestone and black slate, and is generally easy to work, although an occasional annoyance is met with in the shape of horsebacks, etc. The coal is pretty uniformly of a good quality for fuel and steam purposes, although the quality of some portions of the vein is sometimes injured for blacksmiths' use by the presence of small quantities of sulphuret of iron. This is the only seam of coal which is extensively worked at the present time.

The next seam above this is No. 6 of the general section, which outcrops at several points along the Sangamon river, in the vicinity of Petersburg, and is also met with in one or two of the shafts at that place. A peculiarity of this bed, which has prevented its having been worked to any extent except along its outcrop, is the tendency it has to run out, it ranging in thickness, within short distances, from three feet to hardly as many inches. It is a softer and less open burning coal than No. 5, and is therefore sometimes preferred to it for blacksmiths' use.

Iron Ore.—Mention has been made in the preceding pages of the concretions of the carbonate of iron, which occur rather abundantly in the shales overlying the small upper seam of coal near Petersburg. These, however, hardly seemed to occur in any one place in

sufficient abundance to continually supply an iron furnace and render their reduction profitable.

Building Stone.—Probably the best material for building stone in this district is the massively-bedded, light-gray limestone of the Coal Measures, which is quarried on Rock creek, in the southern part of Menard county, and near Salem, about two and one-half miles south of Petersburg. This may be obtained in blocks of any convenient size, and appears to dress easily and weather well. It has, however, been used chiefly for the rougher kinds of masonry only, the limestone from the Joliet quarries, in the northern part of the State, being generally preferred for the finer kinds of work, such as window-caps and sills, etc., wherever it is accessible. I have seen this limestone used as dressed stone in only one or two instances, but it then appeared to answer well. The limestone quarried on the upper portion of Indian creek is also said to answer well for foundations and rough walls.

In the western part of this district a material which seems to promise well as a building stone is the brownish sandstone which occurs in very heavy beds above the roof shales of coal No. 2. This sandstone is usually of a reddish-brown color, though in some places it approaches a dirty white, or has a bluish tinge, is very soft and easily dressed when first quarried out, but is said to harden on exposure. At the junction of this rock and the underlying shales there is generally from one to three feet in thickness of limestone, which has been also quarried to some extent at one or two points. The quantity of this sandstone is such that it is practically inexhaustible; it is probable, however, that all parts of it will not be found to answer equally well as a building stone.

Other Building Materials.—Limestones suitable for the manufacture of a fine article of quicklime are found in several places in the eastern part of this district; each of the localities already noticed as affording limestone as a building stone also furnishes a material for the manufacture of lime. Some selection, however, has to be made among the beds at some points for a material which will afford an article of lime suitable to supply the local needs.

Clay and sand for brick making are found in abundance in all parts of the district, and will, probably, at some future time, become one of the chief sources of building materials in those parts most distant from available stone quarries.

The general surface configuration and soils have been noticed in the first part of this chapter, and but little more need be said. The

soil of the upland prairies in this district takes rank with the best in this portion of the State in general agricultural value. The soil of the timbered portions is also productive when properly cultivated. Along the Illinois and Sangamon rivers, in the bottom lands, there are occasional sandy tracts or ridges, generally covered with a growth of stunted oak and black-jack, which are, of course, inferior, but as a general thing the soil of these bottoms is a deep rich arenaceous loam, which, when sufficiently elevated or properly drained, is one of the most productive soils in the State.

CHAPTER XXII.

TAZEWELL, McLEAN, LOGAN AND MASON COUNTIES.

These four counties, which I describe together in the present chapter, are situated contiguously to each other in the central part of the State, and, together, comprise a very irregularly shaped area, of nearly three thousand square miles. The respective areas and boundaries of the several counties are as follows:

Tazewell county comprises an area of about six hundred and thirty-five square miles, and is bounded on the north by Woodford county, on the east by McLean county, on the south by Logan and Mason counties, and on the west by the Illinois river. McLean county contains an area of a little more than thirty-two townships, or about eleven hundred and sixty-one square miles, and is bounded on the north by Woodford and Livingston counties; on the east, by Ford and Champaign counties; on the south, by Piatt, DeWitt and Logan counties; and by Tazewell county on the west. Logan county lies immediately south of Tazewell and McLean counties; on the east, it is bounded by DeWitt and Macon counties; on the south, by Sangamon county; and on the west, by Mason and Menard counties. It comprises an area of a little more than seventeen townships, or about six hundred and eighteen square miles. Mason county lies south of Tazewell, and east of Logan county; its remaining boundaries are Cass and Menard counties on the south, and the Illinois river on the west; its area is about five hundred and eighteen square miles.

The surface of the country over the greater portion of this district, including McLean, Logan, the greater part of Tazewell, and the eastern part of Mason county, is a high, undulating prairie, with here and there groves and belts of timber. The soil is generally a rich brown mold, varying somewhat in different localities, in the

proportion of clay, etc., which it contains, some portions being more argillaceous than others. In the timber, however, which occupies scarcely more than one fifth or one-sixth of the entire surface, and in the broken country along some of the principal streams, the soil is of a somewhat different character, the lighter-colored and more argillaceous sub-soil appearing at or nearer to the surface.

In the greater part of Mason county, and over considerable tracts in the southwestern part of Tazewell county, the surface configuration varies from that which we have just described; the prairies are low and comparatively flat, and in many portions, were originally overflowed, or marshy, at some seasons of the year. The soil of these prairies is a rich alluvium, generally more or less arenaceous, which forms, when sufficiently elevated or drained, one of the best producing soils in this district. Along the Illinois and Sangamon rivers in this region, we find in some places rather extensive sandy tracts of river formation, and on the Sangamon river, in Mason county, and on the Illinois river, in Mason and Tazewell counties, the bald bluffs of the Loess are in some localities conspicuous features in the general landscape.

The principal streams occurring in this district, besides the Illinois and Sangamon rivers, which form a portion of its borders, are the Mackinaw river, in Tazewell, Mason, and McLean counties, Salt creek, in Mason and Logan counties, and Kickapoo and Sugar creeks, in Logan and McLean counties. These, with many minor streams, and nameless tributaries, drain nearly the whole surface of this district. With the exception on the Illinois and Sangamon rivers, none of the streams have very extensive adjoining tracts of bottom land, and even along these rivers the bottoms are frequently of inconsiderable width, or wanting altogether.

The principal kinds of timber found in the upland wooded tracts of this district are nearly the same as those already enumerated as occurring in the adjoining counties, namely, the principal varieties of oak and hickory, black-walnut, butternut, maple, bass-wood, redbud, sassafras, etc. On the river bottoms, and in low damp lands generally, the sycamore, buck-eye, black-ash, elm, etc., are abundant. The sandy ridges are generally covered with a growth of scrubby oak and black-jack, with a thin admixture of other species.

The geological formations appearing at the surface in this district, consists almost entirely of the Drift and later formations, the older rocks outcropping only at a comparatively few localities, in Tazewell and Logan counties. The underlying rock, however, as far as can be ascertained from these outcrops, as well as from artificial exposures

by shafts, etc., in various parts of the district, consists entirely of the different beds of the Coal Measure series.

The Loess, the uppermost of the more recent geological formations, appears only in the vicinity of the Illlnois and Sangamon rivers, and consists here, as elsewhere, of buff or ash-colored marly sand, containing fresh-water shells of existing species. It is not everywhere equally well developed, and in various localities along the Illinois river, in Mason and Tazewell counties, it either does not appear or is not at all conspicuous. It may be well seen, however, along the Sangamon river, in Mason county, where it appears in the bald, rounded bluffs, with occasional mural appearing escarpments covering their summits, which form so characteristic a feature in the landscape along the river below. In the northern part of Tazewell county, although this buff marly sand appears to some extent in the bluffs along the Illinois river, it is not by any means as well exposed, or prominent, as in the counties farther to the south.

The Drift formation, which covers the older rocks in almost every part of this district, is here composed of beds of blue and brown clay, sand, and gravel, and varies in thickness, in different portions, from fifty feet in the western part of Tazewell county, to two hundred and fifty feet in the Bloomington shafts. It has been penetrated, however, at comparatively but few points, and over the greater portion of this region its depth can only be approximately estimated. It seems probable, indeed, that it may be of this thickness over considerable portions of McLean county, as a boring at Chatsworth, in the adjoining portion of Livingston county, was reported to have penetrated to a depth of two hundred and fifty feet before striking rock.

The material of the Drift in this region appears to be generally roughly stratified; alternating beds of sand, gravel, and clay, are frequently met with in well and borings. The sand and gravel beds generally make up but a very small part of the total thickness, though sometimes single beds attain a very considerable thickness, as, for instance, at Chenoa, in the northern part of McLean county, where a boring for coal passed through a bed of sand and gravel thirty feet in thickness, overlaid by forty-five feet of the usual clays of this formation. Occasionally, also, a bed of black earth or vegetable mold, still containing pieces of wood, trunks of trees, leaves, etc., only partially decayed, is met with, and a bed of quick-sand, containing fossil-land or fresh-water shells of existing species.

The following section of the Drift, afforded by a shaft sunk in the city of Bloomington, is of especial interest as showing both of these conditions at unusual depths. The shaft was sunk by the Bloomington Coal Mining Company, near the track of the Chicago and St. Louis railroad, about half a mile north of the depot:

	Feet
1. Surface soil, and brown-clay	10
2. Blue clay	40
3. "Gravelly hard pan"	60
4. Black mould, with pieces of wood, etc	13
5. Hard-pan and clay	89
6. Black mould, etc	6
7. Blue clay	34
8. Quicksand, buff and drab in color and containing fossil shells	2
Total	254

Another shaft, a little over a mile distant from this one, passed through materially the same succession of strata, with only local variations in the thicknesses of the different beds. The quicksand, No. 8 of the above section, resembles somewhat in appearance the sands of the Loess, and the only species of the contained shells which could be identified was the *Helicina occulta*, which is also not uncommon in the Loess of the river valleys in this State. Beds of black vegetable mould are met with at less depths than in this section at various places in this district, as, for instance, in the vicinity of Pekin, Tazewell county, where it is said, in a few instances, to have tainted the wells which penetrated it to such an extent as to almost render the water unfit for use.

Sections of the Drift are also afforded by the borings for coal which have been made in various parts of this district. In all cases they show variations of the material from blue to yellow clay, sand and gravel, but do not generally afford sections of such especial interest as the shafts at Bloomington, nor is the depth of the formation as great. At Chenoa its thickness was found to be ninety feet from the surface to the rock; at Lexington, one hundred and eighty feet; at Atlanta, one hundred and twenty-six feet; at Lincoln, seventy feet; at Cheney's Grove, one hundred and two feet, and at several points in Tazewell county, from sixty to one hundred feet or more. Its thickness is quite irregular, but seems, however, to be greatest in the central and eastern portions of the district. In Mason county we have no very reliable data upon which to base our estimates, but its average thickness in that portion, I think, may be safely put down at not less than fifty feet, and is probably much more.

In the western part of Tazewell county, in the ravines and broken country along the Illinois river, I observed, in a number of places at the base of the Drift, a bed of cemented gravel or conglomerate,

showing sometimes an irregular stratification similar to that of beach deposits. A ledge of this material, nine or ten feet in thickness, may be seen in the northwestern quarter of section 7, township 25, range 4 west of the third principal meridian, up one of the side ravines which comes down through the Illinois river bluffs, a little south of Wesley City, in Tazewell county, and other similar ledges appear in several places in the vicinity of Fond du Lac, and also on the Mackinaw, in the eastern portion of the county. Another similar bed of cemented gravel, of, however, a comparatively insignificant thickness, may be seen about half way up the face of the bluff, at the steamboat landing in the city of Pekin, where it does not appear to be more than a few inches thick. I have not observed any similar deposits in the eastern portion of the district, either in Logan or McLean counties, nor have I heard of its having been met with in sinking the different shafts or borings.

Coal Measures.—All the stratified rocks which outcrop within the limits of this district belong, as has been already stated, to the Coal Measures, and the actual surface exposures are confined, for the most part, to a thickness of about sixty or eighty feet of the middle portion of the formation. In the whole district there is but one boring which affords an artificial section of the beds down to the base of this formation. This one is that made by Voris & Co. on the bottom lands on the Tazewell county side of the Illinois river, and directly opposite the city of Peoria. The first bed of the Coa Measures which is met with in the boring is about forty feet below the lower coal seam which is worked in this section, No. 5 of the Illinois river section, as given by Prof. WORTHEN.

The following is a section of the first four hundred and fifty-nine feet of the boring. Below that depth the records kept by Messrs. Voris & Co. were not complete as to the thickness and material of all the different beds:

	Feet.
1. Alluvial soil of river bottom	4
2. Sand	4
3. Gravel (boulder drift)	20
4. Clay shale	59
5. Bituminous slate	3
6. Fire-clay	15
7. Clay shale	15
	120
8. Coal	4
9. Clay shale	34
10. Sandy and argillaceous shales (very hard)	34
11. Sandstone	4
12. Nodules of argillaceous limestone	6
13. Compact, fine-grained sandstone	5

	Feet.
14. Hard, dark-blue sandy shale	25
15. Coal	3
	235
16. Sandy and argillaceous shale	25
17. Bituminous shale, with thin bands of limestone	57
18. Cherty rock	44
19. Hard siliceous rock, mainly chert—possibly chert and limestone intermixed	33
20. Fine-grained sandstone	65
	459

As nearly as the limits of the formations can be made out from this section, I think that at least that portion between the base of the Alluvium and Drift, and the bituminous shale and limestone No. 17 of the section, may be referred to the Coal Measures. The remainder is Devonian, with perhaps some of the upper beds lower Carboniferous. The exact equivalents of the two beds of coal passed through may perhaps not be stated with certainty; the lower one, however, is probably No. 1 of the Illinois river section. The greatest depth reached in the boring was seven hundred and seventy-four feet, and the lowest rock was a gray porous limestone, the fragments of which, brought up by the instruments, were exactly similar in appearance to some of the upper limestones of the Niagara group, exposed in the northern part of the State, with which formation this bed may doubtless be properly identified.

The coal seam which is worked in this immediate neighborhood is No. 5, as has been already stated. A good exposure of this coal may be seen near the track of the Toledo, Peoria and Warsaw railroad, at the point of the bluff where the road enters the valley of Farm creek. It is here immediately overlaid by the Loess and Drift, and is about four feet in thickness, the same as its average in other localities thereabouts. It is worked in various places, both in the river bluffs and for a mile or more up the valley of Farm creek, by horizontal drifts into the hillsides, some of which, in their various branches, are of considerable linear extent. The beds overlying the coal are not exposed at the surface at any point north of Farm creek, but the seam is generally found to have a roof of sandstone or sandy shale in the interior portions of the drifts. South of the creek, however, this sandstone is exposed in many places up the side ravines, and in R. A. McClelland & Co.'s shaft, in the center of the southern part of section 34, township 26, range 4, it was found to be twenty-eight feet in thickness between the coal and the overlying drift clay and gravel. This, however, is by no means to be taken as its full average thickness, as at this point it has probably lost much of the upper portion of the bed by denudation.

Passing up a small branch, which comes down through the bluffs from the southward, just back of the village of Fond du Lac about half a mile, I observed a striking exposure of about twenty-five feet in vertical thickness of concretionary sandstone, sandy shales and soft argillaceous sand-rock, which belong to these same sandy strata overlying the lower bed of coal. The more shaly beds cont ined numerous iron-stone concretions, and I observed in the more massive portions what appeared to be indistinct vegetable impressions, but no other fossils. About half a mile or a little more still farther up the ravine the upper vein of coal has been worked to a very slight extent. In actual position it must be at this point at least seventy feet above the coal No. 5, and is possibly still more than that. It is here reported to be about three feet in thickness, and is overlaid by about two feet of grayish fossiliferous limestone, with occasionally an intermediate layer of black slate just over the coal, and forming its roof. Still another seam of coal about fifteen inches in thickness is said to outcrop further up the hollow, but after a careful search I was unable to discover its outcrop, and concluded that it must have been covered by the sliding of the drift, gravel, etc., from the bluffs above.

Along the Illinois river bluffs, between Fond du Lac and Wesley City, there are several points where coal is now or has been worked, and there are a few exposures of the overlying sandstones in the bluffs near the main wagon road. South of Wesley City there are scarcely any exposures on the river face of the bluffs, but up the side ravines they are more numerous. In one of these ravines some distance from the road, on the land of Mr. Davis, I observed the following succession of beds in a vertical exposure for about sixty rods along the sides of the bluffs:

		Feet.	In.
1.	Shale, passing downwards into black slate	25	
2.	Coal	1	6
3.	Fire-clay, passing downwards into nodular limestone	11 to 12	
4.	Limestone	3	
5.	Sandstone, exposed for only a few inches.		

It seems to me probable that the seam of coal observed here is still above both of the coal seams which are worked in this region; the distance between this and the next seam below it I should not judge to be more than forty or fifty feet. The limestone which almost always overlies the coal No. 6 is entirely wanting here, although, as may be seen by the section, a bed of limestone occurs below its under clay and farther down the creek. Below the exposures from which the above section was made up, numerous thin beds of limestone are

to be seen intercalated in sandstone outcrops. These limestone bands appeared to be somewhat fossiliferous, but no good specimens were obtained.

In the northeastern part of section 24, township 25, range 5, on a northern fork of Lick creek, I noticed a small quarry in a ledge of soft light-gray and brown micaceous sandstone, generally thin-bedded and shaly, but in some places with the beds thick enough to answer for building purposes. The total vertical thickness of the exposure was less than twelve feet. Passing farther down the branch, in a general westerly and southerly direction, we find the hillsides along its banks strewn thickly with fragments of similar sandstone, indicating the probable existence of the same beds but a short distance under the soil. At a point on the immediate bank of the creek, near the centre of the section, I observed an exposure of about twenty feet of sandy and argillaceous shales, containing a thin seam of coaly matter not over one or two inches thick at its best development, and from that down to nothing. About half a mile further east, near the center of the eastern line of the section, alongside of the road which crosses the creek at this place, and well up the bluffs, I observed the outcrop of a coal seam which had been worked to some slight extent, and which I take to be the upper workable seam of this region, No. 6 of the Illinois river section. The whole exposure at this point presented the following section:

	Feet.
1. Shale	9
2. Limestone (light-colored)	2
3. Dark-colored shaly beds, in some portions approaching black slate in appearance and texture	2
4. Bluish shaly clay	1
5. Coal	3

Farther to the eastward from this point, and higher in the bluffs, I observed limited exposures of a reddish shaly sandstone or arenaceous shale, which seems, from its position, to overlie the uppermost beds of the above section.

In the vicinity of Pekin there are but few natural exposures of the underlying rocks, but the lower coal is mined at several points in the neighborhood of the city. The coal is generally overlaid by black slate, with, as is stated, in some cases a foot or two of limestone. Above the slate there is generally from twenty to forty or fifty feet of sandstone or sandy shales, according to the locality of the shafts on the edge of the bluffs, or farther up towards the rolling upland. This sandstone may be seen in the bottoms of ditches at one or two points along the Tremont road, about a mile east of the city of Pekin, and in the immediate vicinity of the principal coal mines.

At Mr. Hawley's place, about five miles southeast of Pekin, a shaft was sunk, which passed through both the upper and lower coals, affording a section of the intermediate beds, which, as reported to me, was as follows:

	Feet.
1. Argillaceous shale	4
2. Light-colored limestone	2
3. Coal	4
4. Fire-clay	8
5. Sandstone	50
6. Bluish-black slate	4
7. Coal	4
8. Fire-clay	8

About two miles east of Mr. Hawley's place, in the southwest quarter of section 20, township 24, range 4, on a branch called Lost creek, there is said to be another exposure of brownish sandstone, of very limited extent. I failed to find this locality myself, but if a sandstone occurs here, it may be that overlying the lower coal, or possibly a still higher bed not represented in the above section.

In the central and eastern portions of Tazewell county, there are a few localities where borings, etc., have been made, but satisfactory records of the variation in the strata could not in all cases be obtained. At Rapp's mills, near the center of the north line of section 20, township 24, range 4, a shaft was sunk to the depth of eighty-five feet, and as it was reported to me, struck limestone at that depth. If this be the case, it was very possibly the limestone overlying the upper coal, but, without more reliable data, it is impossible to speak with certainty. The shaft was abandoned before completion, on account of the difficulty of keeping it free from water. At Delevan, in the southeastern portion of the county, a boring was made, which was reported to have passed through sixty feet of sandstone, and, below that, seventy-five feet more of arenaceous and argillaceous shales. No coal was reported in this boring.

In Mason county there are no natural exposures of the older rocks, and, as far as I could ascertain, no good artificial sections are afforded in shafts, wells, borings, etc. Passing eastward, however, into Logan county, we find along Salt creek, some distance above Middletown, a few tumbling masses of bluish limestone, which have evidently come out of the bluffs, but no good exposures. In the southeast quarter of section 13, township 19, range 4, a boring was made in the side of the bluff, by Messrs. Boyd, Paisly & Co., of Lincoln, which passed through one hundred and thirty feet of alternating beds of limestone, and arenaceous and argillaceous shales, passing through the Drift and surface deposits at the depth of only fifteen feet. A seam of coal was also stated to have been met with

near the boring, but its thickness could not be satisfactorily ascertained. I also heard it stated that a seam of coal, about two feet in thickness, had been worked by the early settlers of the county in this vicinity, and afterwards abandoned on account of its poor quality. No traces of the outcrop, or the old workings, are now visible, and I am not able to state, with any degree of exactness, the place in the series of this seam of coal, though it is undoubtedly among the upper beds of the Coal Measures.

At Rankin's mill, about two miles farther up stream, in the northwest quarter of section 7, township 19, range 3, the creek flows over a bed of limestone, which is also quarried at one or two places on the southern bank. The rock is a light-gray, or bluish-gray, irregularly bedded limestone, and contains a few of the common Coal Measure fossils, of which *Spirifer cameratus*, *S. lineatus*, *Athyris subtilita*, and a few others only were collected. Its thickness here, as ascertained by means of a well dug in one of the quarries, was eleven feet; and underneath it was found four feet of black slate, underlaid by seventeen feet of fire-clay, and then six feet of limestone. The hole was continued by boring to a depth of eighty feet from the surface, at which depth a seam of coal was struck, the thickness of which I was unable to ascertain. This, or a similar bed of limestone, outcrops on Lake Fork of Salt creek, in section 23, township 19, range 8, in a ledge about three feet high, which has been quarried to a slight extent at one point, near the center of the section.

The above comprises all the natural exposures within the limits of the district. There remain, however, various shafts, borings, etc., which, over the larger portion of the territory, afford us the only means whatever of ascertaining the character and thickness of the underlying beds. Of these, with one or two exceptions only, the shafts alone furnish sufficiently reliable sections of the strata, and as yet but two or three have been sunk. At Lincoln the shaft afforded the following section, after passing through about seventy feet of soil and Drift:

	Feet.	In.
1. Light-blue arenaceous shale	6	0
2. Hard, bluish, impure limestone, containing many small corals, etc	3	0
3. Black slate	0	10
4. Coal	1	6
5. Fire-clay	6	0
6. Arenaceous shale	3	0

NOTE.—Since this report was written, the shaft at Lincoln has been completed down to the coal, but we have not been able to get any response to our application for a copy of their journal, and consequently cannot state definitely the thickness of the coal seam or its depth below the surface. A. H W.

The black slate which had been taken from the shafts was too much decomposed at the time of my visit for me to obtain from it any well preserved fossils, although amongst the rubbish I observed various undistinguishable fragments of what had apparently been fossil shells. The coal in this section is probably not below No. 6 of the Illinois river section, and may possibly be still higher. About four miles south of Lincoln, on the land of Mr. J. Braucher, near the center of the south line of section 14, township 19, range 4, a hole was sunk by boring to the depth of near two hundred and fifty feet, and three separate seams of coal were reported to have been met with. Unfortunately, however, the particulars of the variation and thickness of the beds could not be obtained, and we are therefore unable to form an opinion as to the equivalents of these seams. In a boring at Atlanta, in the northern part of the county, a seam three feet and six inches thick was reported at the depth of two hundred and forty-two feet, the overlying bed, as reported, consisting of alternating strata of "slate," "soapstone," "rock" (limestone?), etc. This is probably coal No. 6, although, without more positive evidence than is afforded by an isolated boring, nothing can be stated with absolute certainty.

The two shafts at Bloomington, which have been mentioned in the remarks concerning the Drift, in a previous portion of this chapter, afford us the most satisfactory section of any of the excavations in the district, enabling us to identify the two seams of coal which they penetrate, with numbers 5 and 6 of the general Illinois river section. The following section, made up from records afforded by both shafts, illustrates well the variation of the strata of the middle Coal Measures in this region. This section commences at the base of the Drift, and its upper portion, from 1 to 4 inclusive, was afforded by the Bloomington Coal Company's shaft, and the remainder by that of the McLean County Coal Mining Company, a mile further south, along the railroad track:*

	Feet.
1. Clay shale	16
2. Sandstone	32
3. Clay shale	1
4. Coal No. 6	4
5. Fire-clay	13

*Since this report was written, the McLean County Coal Company have extended their shaft down to a lower coal, which they struck at the depth of 513 feet 8 inches below the surface. The following is the section below No. 5 coal:

	Feet.	In.
Fire-clay	10	
Slate	3	
Fire-clay	4	6
Sand-rock	20	6

—This foot-note continued on next page.

		Feet.	In.
6.	Limestone	2	7
7.	Fire-clay	10	
8.	Clay shale	8	
9.	Fire-clay	15	
10.	Shale	5	6
11.	Soft blue slate	22	7
12.	Black slate	5	
13.	Coal No. 5	4	6
14.	Fire-clay	6	9

No. 2 of this section is a light-colored laminated sandstone, containing a few remains of fossil plants; in the more southern shaft it seems to be replaced by a conglomerate. No fossils were obtained from any of the other beds, excepting the black slate (No. 12) over the lower coal, which contained in great abundance *Lingula mytiloides*, *Aviculopecten rectilaterarius*, *Cardina ? fragilis*, and other fossils characteristic of this coal. A rather peculiar feature, however, is the comparative rarity of *Discina nitida*, usually the most abundant fossil in this slate, only one or two specimens being found in a rather protracted search.

In the northern and eastern portions of McLean county we have only the records of several borings, which afford but few particulars as to the character of the underlying beds. Just over the county line, in Livingston county, about two miles from Chenoa, in a northeast direction, a ledge of bluish-gray, irregularly-bedded limestone outcrops in the side of a ravine. In general appearance this rock is very similar to that noticed in the preceding pages as occurring on Salt creek in Logan county, and like it, is probably in the upper part of the Coal Measures.

Economical Geology.

Coal.—From the preceding remarks it will be seen that although at least four or five different seams of coal underlie different por-

---

	Feet.	In.
Soapstone (clay shale)	62	5
Black slate	2	7
Fire-clay	1	7
Sulphurous rock	1	2
Gray slate	11	1
Shale	1	2
Hard, lime rock	2	1
Gray slate	2	8
Soapstone (clay shale)	6	8
Coal	3	8

The distance between these lower seams is 133 feet 1 inch at this shaft, and from the thickness of the seam, and the character of the associated beds, I am inclined to regard the lower coal in this shaft as No. 3 of the Fulton county section, given on page 341. It is possible, however, that No. 3 is represented in this shaft by the 2 feet 7 inch bed of black slate, and that the lower coal here is really No. 2.

A. H. W.

tions of this district, but two of them have been worked to any extent. The upper of these two, No. 6 of the general section, is worked to a slight extent along the Illinois river, in the neighborhood of Pekin and Peoria, and is also the upper seam in the Bloomington shafts. Its thickness in these localities ranges from three to four feet. The coal in this bed is generally softer, and often more impure, than that of the next seam below, and its workings have frequently been forsaken for those of the lower bed. The sixteen-inch seam of coal, which has been mentioned on a preceding page as occurring on a ravine a short distance back of Wesley City, and which I have there considered as a still higher seam of coal, may possibly be this seam, in spite of its lesser thickness, as it is a characteristic of this bed in other parts of the State where it has been identified to vary considerably in its thickness, in some cases, indeed, thinning out very rapidly within the distance of a few feet. The more reliable indications of the accompanying limestone beds, with their characteristic fossils, cannot under all circumstances be well observed, nor, indeed, do they appear to be invariably present.

The lower coal, No. 5, is the seam which is now mined in nearly all the principal workings within the limits of this district, and will generally average here at least four feet in thickness. The coal is generally a harder and better heating material than that in the upper bed, besides being more reliable in its thickness. It, however, contains, in some parts, its share of impurities, but often so disposed in the vein as to be more easily separable. In some of the shafts near the city of Pekin, the seam of coal, which I have referred in the preceding pages to this horizon, contains in its lower portion, about sixteen or eighteen inches above the base, a thin seam of fire-clay separating it into two unequal portions, and sometimes a vein of slate, or slaty coal, is reported to occur only five or six inches above the bottom. In the upper portion, also, there is frequently some thickness of what is called "hickory," or mixed coal and shale, or sand-rock. The thickness of good coal, however, is sufficient to render its working profitable.

At Bloomington the shafts were first sunk only to the upper coal, which was worked for a short time, and then the shaft having been deepened, the upper bed was abandoned, and only the lower seam was worked. The difference in quality was very marked at this place, the lower coal being very much superior to that of the upper seam.

Beneath this coal No. 5 we find, by the boring opposite Peoria by Voris & Co., two seams of coal at the depths of one hundred and twenty and two hundred and thirty feet, and respectively four and three feet in thickness, which are most probably the equivalents of Nos. 1 and 3 of the general section referred to. Although we have no positive data as to the existence of these or other beds under the coal No. 5 in other portions of the district, yet, from their existence at this point, and from our general knowledge of the development of the lower Coal Measures in this portion of the State, it seems quite probable that these seams of coal might be found at the proper depth in other parts of this and adjoining counties. A boring of from two hundred to two hundred and fifty feet below the known horizon of No. 5, or from five to seven or eight hundred feet from the surface in different parts of the district, would probably penetrate all the Coal Measures, and settle all the questions in regard to the existence and development of the underlying coal seams.

The upper coal seams are perhaps represented in this district by the bed reached at the Lincoln shaft, and it may be also by the small seam near Wesley City, in Tazewell county, which I have, in the preceding pages, referred with doubt to a higher level than No. 6, though still admitting its possible identity with that bed itself.

In neither of these localities is the seam of sufficient thickness to be worked with much profit, except where it might, perhaps, be profitably worked in a small way by stripping along the line of its outcrop.

Building Materials.—This district, as a whole, is within itself but scantily supplied with building stone, the greater portion of its surface being occupied by the Drift deposits, and containing no exposures whatever of the older rocks. Along the Illinois river, however, in Tazewell county, the sandstones of the Coal Measures have been quarried to some extent to supply the local demand, and in some localities appear to afford a stone suitable for foundations, cellar walls, etc. The limestone beds which also occur in the Coal Measure strata in this region, though generally of inconsiderable thickness, may also furnish a limited supply for the same purposes, as well as for the manufacture of lime. The limestone ledges noticed as occurring on Salt creek and Lake Fork, in Logan county, also furnish a fair material for the rougher kinds of masonry, and have been considerably quarried for this purpose. Dimension stone, etc., when used in this district, are brought from beyond its limits, in great measure, from the quarries at Joliet.

Clay and loam suitable for the manufacture of a fair quality of red brick are found in nearly all parts of the district and have been made use of in most of the principal towns within its limits. Sand for building purposes is also sufficiently abundant.

Mineral Springs.—We may, perhaps, properly mention again, under this head, the artesian well sunk by Messrs. Voris & Co., on the edge of the bottom land along the Illinois river opposite Peoria, in which a current of water, holding in solution sulphureted hydrogen, was struck at the depth of seven hundred and thirty-four feet. When struck it was stated to have had a head of sixty or seventy feet, and the flow is said to be nearly as strong at the present time. This water appears to be derived from the upper portion of the Niagara group, but before the boring had reached its present depth a strong stream of saline water was met with at a distance from the surface of three hundred and seventeen feet.

Copperas and saline springs occur in various places in this district, and occasionally give names to some of the minor streams. Such names as Salt creek and Lick creek occur here, as in other parts of the State. These springs, however, are few in number, and can hardly be considered of any economic value.

It is, perhaps, superfluous to mention at length the agricultural capabilities of this district, since the capacity of its soils, etc., are so well known, and its territory is so generally taken up by actual settlers and now under cultivation. I may safely say, however, that with the exception of some sandy portions along the principal rivers there are no extensive tracts of what can be called poor land in the district. There are, indeed, some tracts of comparatively low bottoms and marshy land which are not at present available for all kinds of agriculture, but these are generally of limited extent, and are rapidly diminishing under an improved system of drainage, which places them at once among the more valuable lands of the district. The numerous railroads now traversing this region, and others projected or in process of construction, by making all portions readily accessible to the centers of trade, will add greatly to its present wealth and guarantee its future prosperity.

CHAPTER XXIII.

GRUNDY COUNTY.

Grundy county is bounded on the north by Kendall, on the east by Will and Kankakee, on the south by Livingston, and on the west by LaSalle. It includes twelve townships, or about four hundred and twenty square miles, forming a rectangle of twenty-four miles long and about seventeen and a half miles wide. Of this, about two-thirds is slightly rolling prairie and the balance mostly well timbered creek banks and river bottoms.

The Illinois river divides the county near the middle of its northern half, running in a W. S. W. course, with but little variation. Its principal affluent on the south is Mazon creek, which drains fully one-third of Grundy, and portions of Livingston, Kankakee and Will counties. Its principal water supply is from surface drainage, but few springs being found along its course. From this character, one would readily predicate the truth that a very wet season often causes it to overflow its banks, though twenty feet or more in height, while a dry one leaves its bed bare, except where deep pools have formed. The summer of 1867, dryer than a score of its predecessors, gave me an unusually fine chance for the exploration of the stream, as well as all others included in this season's work.

A few miles west of the Mazon is the Waupecan, draining a comparatively small extent of country, but, in an ordinary season, carrying nearly as much water, the product of several strong springs on the lower part of its course—some of them from the Drift, others from the sandstones and shales of the Coal Measures, which here show a small outcrop. Still farther to the westward, are Billy run, Hog run and Armstrong run, which are simply prairie drains, and show no outcrop of rock. Nettle creek, on the north side of the river, is principally of the same character; but in the lower part of

its course there are a few springs and two or three outcrops of the shales and sandstones which overlie the lower coal. Finally, in the northeast corner of the county, is the Au Sable creek, with a comparatively large amount of water, partly derived from springs and partly from drainage of this and part of Kendall county.

Post-Tertiary Formations.

Alluvium.—The beds of this formation are very largely developed in the terraces of the river valley and the beds of the smaller streams. From the west line of the county nearly to Au Sable creek, the Illinois and Michigan canal follows the north bank of the present river valley pretty closely, while the second terrace varies from a half to two miles to the northward. On the south side of the river the high gravelly banks of the second terrace hug the river banks very closely as far as the Waupecan creek. Here they lose much of their elevation, and have as their continuation a low ridge about a mile distant from the present bank. East of the Mazon creek this declines still more, and becomes the heavy sand ridge which bears still farther southward, and then eastward, south of Wilmington, into Kankakee county. This sand ridge forms the water-shed between Mazon creek and Kankakee river, so that, where it strikes the bank of the latter stream, to the southward of Wilmington, the water flows from within two hundred yards of the river, through swamps and sloughs, and finds its way, through the Mazon, into the Illinois opposite Morris.

The flat of the old river valley, back of the present banks, show in many places plain evidence of the comparatively recent date of their formation. At Gen. Birney's place, on section 11, township 33 north, range 6 east, my attention was called to the fact that at a short distance beneath the surface, at a pretty uniform depth through that neighborhood, there is a layer of thin slabs of the fossil sandstones of the Coal Measures, still tolerably solid. They were evidently distributed here by the current of the river not long before it became so contracted as to leave this level dry. When this old channel was the outlet of Lake Michigan a large body of water must have flowed through here, and appearances seem to indicate that its diversion toward Niagara must have been sudden rather than gradual; otherwise, the present valley would probably have been wider and the descent to it less abrupt.

A topographer would take peculiar pleasure in studying the various islands of the old valley, especially at the confluence with the

Illinois of Au Sable and Nettle creeks, both of which streams, apparently, were much larger than at present. Upon one of these islands stands Morris, the county seat.

Another, and far the largest in the county, is the high land lying between the head of the Illinois, the lower part of the Kankakee and the slough which contains Goose lake, and runs thence to Pine Bluff, near the embouchure of the Mazon, upon the Illinois valley.

The following levels of points within this county have been furnished to me mostly from the notes of the Illinois River Survey, from the office of its chief, Gen. J. H. Wilson, U. S. A., now in charge of the river improvements at Keokuk, Iowa. The figures indicate distances *below* the established "datum of six feet below the lowest registered water of Lake Michigan":

	Feet.
Bluffs at Morris, north side (level of town)	55.938
Bluffs at Morris, south side	59.48
Bluffs at Morris, south side, lower terrace	78.00
Level of river, at head of the Illinois	87.809
Level of river, at mouth of Au Sable creek	92.664
Level of river at Morris, under road bridge	95.13
Level of river at Marseilles, LaSalle county, above dam	99.808
Level of river at Marseilles, LaSalle county, below dam	103.256
Level of river at Goose lake, about	60.000
Level of river at Minooka, as per railroad survey, *above datum*	35.000

These levels show that the elevation of the first terrace above the river, opposite Morris, is a little over seventeen feet, and that the elevation of the second bluff or gravel ridge above the first terrace is about eighteen and a half feet. The present floods reach nearly up to the first terrace; and it is probable that when the lake poured its waters through here, even the much wider valley of the old river did not so accommodate the floods as to prevent their nearly or quite overflowing the gravel ridge, and covering large portions of the upper terrace, both north and south of the river.

The coarser portion of the beds of the river gravel consists mostly of fragments of the Niagara group limestone, which forms so heavy beds from below Joliet to Chicago and beyond. Much of the sand is probably due to the disintegration of the Coal Measure sandstones, while some of it may have come from the northward. There is, however, in these beds but a very small proportion of the metamorphic material from Canada, which forms so large a part of the true Drift, but upon the *surface* of the soil, and often partially buried, are great numbers of small boulders of quartzite, gneiss, granite and trap, unquestionably of Northern origin. These are especially abundant south of Goose lake, over the surface of the valley which starts from the Kankakee near the county line, includes

Goose lake, and joins the Illinois valley near where the Mazon first strikes the bottoms. This was probably a shallow channel, in which floating fields of ice lodged, melted and dropped the loads of stone which they had brought from the northward. Similar aggregations of boulders occur in the adjacent parts of Will county, at points where eddies would have been likely to detain the ice floes. I have suspected that this Goose lake channel was formerly the main channel of the Kankakee, which thus met the DesPlaines only four miles above Morris; but I have not collected sufficient data to decide the point.

The bed of "potter's clay," worked near the southwest bank of Goose lake, and lying "near the level of the fire-clay," (see vol. I of the original report p. 58), owes its origin and deposition to river action, though principally consisting of the decomposed shales and fire-clays of the Coal Measures.

During the autumn of 1868 the remains of a *Mastodon* were found at Turner's stripping, about three miles east of Morris, under eighteen inches of black mucky soil, and about four feet of yellowish loam, and resting on about a foot of hard blue clay which covered the coal. The bones were badly decayed, and most of them were broken up and thrown away by the miners; of the remainder, Mr. Joseph Even, of Morris, with his usual zeal for science, obtained and presented to the State Cabinet, a part of a thigh bone, a fragment of a lower jaw, three teeth, and a few of the small bones. The locality is a portion of the old river bottom, and, in the lack of personal observation, I am uncertain whether to believe that the presence of the bones indicate that the animal was mired and died here, or to suppose that the carcass was deposited here by the river.

The Coal Measure rocks of this county are too soft and too readily disintegrated to allow of the preservation of any scratches that may at any time have been impressed upon their surface; so that, although we find in the gravel very numerous scratched and polished pebbles and boulders, it is within only a very small area that striated and polished rock surfaces have been noticed. In the southeast quarter of section 23, township 34 north, range 7 east, at Wraters' quarry of Trenton limestone, smoothly polished surfaces have been frequently met with. In the southwest quarter of section 16, township 34 north, range 8 east, Collins' run exposes a small surface of the shaly limestone of the Cincinnati group, upon which are plainly marked three sets of striæ, running, by compass, north 30° east, north 37° east and north 50° east. In the southeast quarter of sec-

tion 19, of the same township, the surface of the black slaty shale which overlies the coal at Petty's shaft, is scratched and polished in a similar manner. As these three localities, however, are all within the old river valley, we cannot, with certainty, predicate upon these facts the conclusion that those scratchings and polishings are attributable to glacial action. In fact, these and some other circumstances give some reason for assuming that they are results of river action alone. At the coal mine we find the outer portion of the shale next to the creek bank broken up for several feet, and thoroughly mingled with the drifted materials which here form an overlying bank of about fifteen feet. This disturbance, as well as the grinding of the surface, we may fairly attribute to the action of the creek while at its former level. But, while allowing that, in these particular cases, river agencies are sufficient to account for all observed phenomena, we must also record the frequent occurrence in the Drift gravel of large and small boulders unquestionably planed and striated by glacial action. These are especially abundant along the Mazon.

The True Drift in the western part of the county consists, mainly, of the tough, blue "boulder clay," with pebbles and boulders, sometimes also including fragments of wood, overlaid but slightly, or not at all, with gravel, and underlaid, so far as known, with a bed of "hard-pan" and a water-bearing quicksand which has thus far prevented any knowledge of the underlying materials. The eastern part of the county, on the contrary, shows but little boulder-clay, this being replaced by a heavy layer of sand and gravel. Township 34 north, range 6 east, has no known outcrop of rock, and wells near its south line have reached depths of forty-eight, fifty and fifty-two feet, before meeting the quicksand. Townships 31 and 32, of the same range, and so much of 33 as lies south of the river, together with townships 31 and 32, range 7 east, possess no outcrop of rock, but the depth of the Drift is not known. At Gardner, in section 9, township 31 north, range 8 east, the Drift is said to be one hundred feet deep at the coal shaft. At Braceville, section 25, township 32 north, range 8 east, it was found to be forty-four feet deep. Going northward into township 33, in ranges 7 and 8, it rapidly thins out, owing partly to the downward slope of the surface, partly to the upward slope of the surface of the underlying rocks, which come to the surface in the northern part of these townships. Much of the "coal land" in the immediate neighborhood of Morris is bare of Drift, having been stripped by the old river. To the northward, however, through township 34 north, range 7 east, the gravel and boulder-clay lie—in some places forty feet deep.

Township 34 north, range 8 east, is deeply buried in Drift. At Minooka, on the line between sections 1 and 2, a well-boring found one hundred feet of gravel overlying the shaly limestone of the Cincinnati group.

Rock Formations.

Coal Measures.—The beds of the Coal Measures occupy far the larger part of the surface of the county. The outcrops, however, are so disconnected and the beds so irregular that I have been unable to construct any general section to represent connectedly all the outcrops. Apparently the higher beds exposed in the county are those which outcrop near the old coal openings on the Waupecan, in the southeast quarter of section 20, township 33 north, range 7 east. I was unable to find any outcrop of beds above the coal, and did not learn whether any were seen in the deeper parts of the mine. Near the outcrop a foot of coal was left as a working roof. The seam is five feet thick, resting on a bed of fire-clay. It is coal No. 3, of the Illinois valley section. The connection below is not exposed, but at a short distance from the floor of the seam, not over ten feet, we came upon a coarse, ferruginous, shaly sandstone, filled with fragments of *Lepidodendron*, *Calamites*, *Neuropteris hirsuta*, etc., with an occasional streak of coaly matter. Of this bed, there is a low, nearly continuous outcrop for a mile up the stream, the last spot observed being at "Hog Grove quarry," in the southwest quarter of section 28. At the road-crossing, about half a mile down the creek from the coal mine, the sandstone rises a little, and exposes about six feet of blue and black shales, filled with small Mollusca of the genera *Pleurotomaria*, *Macrocheilus*, *Euomphalus*, *Orthoceras*, *Nucula*, *Aviculopecten*, *Productus*, *Chonetes*, *Hemipronites*, etc., and yielding some small remains of fish, such as *Petrodus occidentalis*, and the type of the new Crustacean, *Ceratiocaris* (?) *sinuatus*, M. and W. The lower part of the blue shale holds two thin layers of rusty, brown nodules of carbonate of iron, which often partially or wholly include shells of the above named Mollusca. The upper part of the black shale also contains nodules of the same material (with probably some phosphate of lime), but smaller and less evenly distributed; the smaller of these contain comminuted scales and bones of fishes, and, judging from both form and contents, are probably the fossil excrement of larger fishes. These beds, with others, outcrop at intervals for about a mile along the right bank of the stream; and the following section will fairly represent the whole:

		Feet.
1.	Sandy shale	5
2.	Blue clay shale	3
3.	Fossil sandstone	15
4.	Blue clay shale, with iron nodules	2 to 5
5.	Black shale, top slaty, with small nodules, bottom very fragile	2 to 3
6.	Cone-in-cone, locally becoming a solid limestone	½ to 1½
7.	Soft olive shale	1½
8.	Solid gritty sandstone	1

Another outcrop, on nearly the same horizon, occurs on Mazon creek, from the center of the south line of the southwest quarter of section 6, township 32 north, range 8 east, to near the center of the south line of section 25, township 33 north, range 7 east. The strata are here very irregular in thickness, but the following section gives an average representation of the exposed outcrop:

		Feet.	In.
1.	Ironstone conglomerate (local)		6
2.	Sandstone	8	
3.	Black shale, some slaty, with large ironstones	3 to 4	
4.	Cone-in-cone, running into massive limestone		2 to 6
5.	Olive shales, changing into concretionary argillaceous limestone	5 to 7	
6.	Soft black shale	2 to 3	
7.	Blue clay shale		9
8.	Coal No. 3 (?)	2	
9.	White fire-clay	?	

Small quantities of coal have been mined at this seam at several points along the limited outcrop. The latest opening was by Mr. Harold, for his own use, just back of his house, on section 1, township 32 north, range 7 east. The coal was said to be good house fuel, but rather soft; none could be found at the time of my visit. The argillaceous limestone of No. 5 of this section generally contains numerous shells of the genera *Productus*, *Athyris*, *Terebratula*, etc., and some fragments of crinoids. The coal apparently holds the position of the thin coal which locally underlies No. 56 of the LaSalle county section.

The outcrop along the Mazon appears nearly continuous, but still I have not been able to satisfy myself as to the connection of the above beds with those of the lower part of the stream. The strata there developed consist of very variable sandy clay shales and sandstones, in some places becoming nearly pure clay shales, but containing many nodules of carbonate of iron. Pine Bluffs, at the lowermost crossing of the Mazon, is composed of about forty feet of heavily-bedded but rather fissile sandstone, partly nearly white, partly highly ferruginous. Less than a mile up the creek the lower part of this bed changes to highly argillaceous sandy shales, with occasional streaks and nodules of sandstone. The section is not quite continuous, but there is no distinct line of demarkation to separate these latter beds from the ferruginous sandy shales, twenty

to thirty feet thick, of section 24, township 33 north, range 7 east, which contain large numbers of the fossiliferous nodules of carbonate of iron, for which this locality has become famous.

These nodules range from about two to about ten feet above the main coal seam of all this region, the intervening space being occupied by the soft, blue clay shales, filled with fossil plants which, at most points, overlie this seam.

About a mile farther up the stream coal has been dug in the bed and banks of the stream, but is now abandoned. Still farther south, near the southeast corner of section 19, township 33 north, range 8 east, a shaft was recently sunk, by Mr. Wm. Burt, upon the creek bottom, starting at about twenty-five feet below the general level of the prairie. The section is as follows:

	Feet.	In.
Blue clay and sandy shale, with ferns	20	
Coal	3	
Soft black shale		6 to 8
Fire-clay, with rootlets		6 to 8
Hard sandy clay		8
Fire-clay	2	6

At this place the coal is about eight feet below the bed of the creek. Near the water level an off-shoot from the main seam, about seven inches thick, is exposed in the bank; the shales immediately over it afford a few plants.

Near the center of section 18, township 33 north, range 8 east, Mr. John Holderman's artesion well has afforded the following section, kindly furnished by Mr. A. J. Henry, who had the charge of the boring:

	Feet.
Gravel	15
Sandstone	34
Coal	3
Sandy shale	88
Limestone	185

It will be noticed that this section gives the sandstone as immediately overlying the coal. This condition of the seam has been elsewhere noticed, so far as I can learn, only in a shaft recently sunk near the southeast corner of section 9 of the same township, and in one shaft in the adjoining part of Will county.

Mr. Henry has also furnished me the section of the well bored by him at the railroad station in Morris, from which an abundance of water is now flowing, as follows:

	Feet.	In.
Shale, with sandstone layers	63	
Coal	2	10
Fire-clay	4	
Shales and clays	100	
Hard limestone, "Trenton"	200	
White sandstone, "St. Peters"	57	

On the north side of the Illinois river, in the neighborhood of Morris, the coal outcrops in the bank of the canal, and in the stretch of low land about one mile to the northward. The overlying beds are here mostly blue clay shales, with occasional irregular layers of sandstone. The iron nodules above mentioned occur here at the same level, but not in so great numbers as at the Mazon locality. The shales immediately above the coal frequently yield magnificent specimens of fossil ferns and other plants. The following section of the seam and its overlying beds was obtained at the shaft of Messrs. Symonds and Jones, just south of the railroad station at Morris:

	Feet.
Boulder clay	8
Ferruginous sandstone	1
Shale	20
Shaly sandstone	19
Shale, filled with fossil ferns	12
Coal	3
Soft slaty coal	1
Fire-clay	3

In the north part of township 33 north, range 6 east, the shaly sandstones overlying this seam are exposed in the bottom of every little run which cuts away the soil from the edge of the second terrace, and fragments of them are found scattered just below the surface over the whole lower flat.

It has long been a favorite theory with miners that another seam of coal could be found by sinking shafts in the bottom of the present working. This is not impossible at points farther from the outcrop; but at Morris, and to the eastward, the coal lies directly upon the lower Silurian rocks, with only four or five feet of fire-clay to separate them. This is shown at several points.

I had supposed that the seam had formerly extended, in its full thickness, much further northward; but two wells, one in section 27 and the other in section 13, township 34 north, range 7 east, after passing through the fossiliferous shales which overlie the coal, met with only about ten inches of soft coaly shale, underlaid by a few inches of greenish clay shale, with small rounded grains of calcareous (?) matter (probably belonging to the Cincinnati group), which rested upon the solid limestones of the Trenton. The artesian boring of Mr. Samuel Holdeman, in the northeast quarter of section 3, township 33 north, range 8 east, after passing through forty-seven feet of sandstones and clay shales which, everywhere to the southward of that point, overlie the coal, passed directly into a solid limestone which I can only refer to the Trenton group. From this and similar facts, I am led to the conclusion that the present line

of workings corresponds very nearly with the original outline of deposit of the true coal seam, while beyond this line only occasional small outlying patches will ever be found, though thin layers of coaly shale may be met with some miles further northward. On the Au Sable creek, a few miles north of the county line, small quantities of coaly shale and cannel coal have been found, but they are probably of no practical value, and have no direct connection with the Morris seam.

Upon the lower part of the Au Sable, however, in the southeast quarter of section 19, township 34 north, range 8 east, there is a peculiar outcrop of probably the lower seam. We have here a seam of coal twenty-eight inches thick, with a floor of fire-clay at least six feet thick, and a roof of black shale which is, at the outcrop, quite solid and a foot thick; but at the shaft, perhaps fifty yards distant, it thickens to between five and six feet, and becomes quite soft. This shale has yielded a few small *Discina* and *Lingula*, and a few fragments of fish scales; but these are not sufficient to determine its position in the series. The bed seems to be but a small outlier, covering only a few acres, as borings to the southward and westward have failed to find any continuation of the bed in these directions, while to the northward and eastward the shales and limestones of the lower Silurian outcrop within a few hundred yards. I am still uncertain whether this is a locally peculiar condition of the main seam, or lies above or below it. If it be the main seam, the black roof shales are probably the equivalent of the bed mentioned in the LaSalle county section as lying there about eighteen feet above the coal; but no other outcrop of it has been seen in this part of Grundy, though it appears in Wilson's shaft, in the southeast corner of the county.

Another peculiar outcrop of uncertain connections is along the Kankakee, from the east line of the county to the "Head of the Illinois," in section 36, township 34 north, range 8 east, where the river has cut through some fifty feet of shales and sandstones of the Coal Measures, including a thin seam of coal, and has reached the underlying shaly limestone of the Cincinnati group. A few indistinct plants have been met with in the sandstone, but in too poor condition for specific determination. The following section was taken on the west bank of the river, about midway of the length of the exposure as above named:

	Feet.	In.
1. Soil and gravel		2
2. Boulder clay		2
3. Dark purplish shaly clay		2

		Feet.	In.
4.	Ferruginous shale		3
5.	Coal		10
6.	Coaly shale, with thin layers of sandstone	8 to 10	
7.	Sandstone		6
8.	Gypciferous clay		3
9.	Olive shales	3	
10.	Ash-colored shales, with limestone nodules		8
11.	Limestone of Cincinnati group.		

In the other parts of the outcrop, the ash-colored shales, No. 10, contain as many as six distinct layers of the limestone nodules, which appear like good material for making hydraulic cement. The sandstone, No. 7, thickens to the southward, and forms at least fifteen feet of the bluff at Schoonmaker's ford, on the county line, where it contains many spherical concretions, both large and small, and a few indistinct *Lepidodendra* and *Calamites*.

The coaly shales, No. 6, become more carbonaceous in the same direction, and finally are replaced by a true coal, which, with No. 5, forms a layer which is known in the neighborhood as the Schoonmaker coal, and is found to be ten and a half feet thick at Schoonmaker's shaft, near the center of section 7, township 33 north, range 9 east. Its relation to the other seams is still doubtful (See further, Report on Will county).

In ascending the DesPlaines river from its junction with the Kankakee, the sandstone of the above section, No. 7, is found at intervals for about two miles on the south bank, but does not cross the river above the "feeder" aqueduct, at Old Kankakee.

The outline of the Coal Measures in this county may be roughly stated as a line running from near the northwest corner of the county, with some variations, in an east-southeast course, to the mine on Au Sable creek, just above the railroad; thence southeasterly to the Goose lake slough, and easterly to the east end of the lake; thence northerly to the mouth of the Kankakee.

Cincinnati Group.—The shales and shaly limestones of this group outcrop in the northeastern part of the county, showing most prominently upon the high ground between Goose lake and the head of the Illinois river. This outcrop consists of coarsely granular, highly fossiliferous, ferruginous limestones, readily disintegrated by the weather, which have been used, to some extent, for fences. This outcrop continues southward for about a mile, and forms the bottom of the north half of Goose lake, the south half being underlaid with coal. At the ford of the Kankakee, in the northwest quarter of section 36, township 34 north, range 8 east, beds of soft blue shaly limestone, which probably lie near the base of this group, out-

crop in the bed of the river, but show little upon the bank, and contain but few and indistinct fossils.

From the bed of the canal, a half mile west of Dresden, there were thrown out considerable quantities of a heavy but rather cellular ferruginous limestone, in heavy layers, probably belonging below the beds above mentioned. The outcrop at this point did not quite reach the surface. Over most of the county north of the Illinois, the Alluvial and Drift deposits cover the country so deeply as to allow of outcrops only along the streams.

In ascending the Au Sable creek from the railroad, we frequently see scattered fragments of the shaly limestones of this group, but meet with no outcrop until we approach the middle of section 3, township 34 north, range 8 east, where small quantities of stone have been quarried for wells and underpinnings. From this point there is a nearly continuous outcrop to some distance above the county line. Fossils are numerous, such as *Chætetes lycoperdon*, *Pleurotomaria bilix*, *Orthis testudinaria*, *Leptæna sericea*, *Ambonychia radiata*, *Calymene senaria*, etc. These beds were struck at one hundred feet, in a boring through the boulder clay at Minooka.

A small outcrop of rock of this age is exposed in the bed of Collins' run, a branch of the Au Sable, in the southwest quarter of section 18, of the same township. The rock here is a rather more solid limestone, breaking irregularly and containing but few fossils. It is reported that similar small outcrops occur farther up this run, but they have not been opened so as to know whether stone of any value can be obtained. Similar outcrops were observed in the bottoms of ditches near the middle of the north line of township 34 north, range 7 east. In the borings about Morris, only a few feet of beds which can be referred to this group, are found between the Coal Measures and the underlying Trenton limestone, and to the northward of that place no such beds have been found.

Trenton Limestone.—The two remaining outcrops of rock in this county are limestones of the Trenton group, probably near its top. The principal one is near the center of section 24, township 34 north, range 7 east, where Mr. H. Waters has for some years quarried stone for building and for making lime. The top layers of the quarry are thin, and somewhat stained with iron. Below these the rock is a heavily-bedded gray or light-drab fine-grained clinking limestone, not very rich in fossils, but yielding some good specimens of *Receptaculites*, *Illænus*, *Strophomena*, *Orthis*, *Discina*, *Murchisonia*, *Orthoceras*, etc. These have been penetrated to the depth of twenty feet without exposing any other layers; but it is said that at one

point the drill passed into a pocket of a softer black material, which strengthened the owner's previous opinion that the coal seam extended under his quarry. Possibly this may have been a small deposit of carbonaceous material analogous to the petroleum which this rock has yielded in small quantities in the vicinity of LaSalle. These beds contain small portions of pyrites (sulphuret of iron) disseminated through the whole mass. There were also occasional streaks of soft clay. The quarry has exposed two sets of crevices, one trending south 45° west, and the other south 35° east. These crevices are filled with a fine clay, of very nearly the same color as the limestone, through which are sparsely disseminated small crystals of blende (sulphuret of zinc), with occasional pyramidal crystals of pyrites; no galenite has been observed.

The remaining outcrops of this rock are in the beds of the Au Sable, on the two sides of the yoke-like bend in the stream, in the east half of the northeast quarter of section 19, township 34 north, range 8 east, and consists of small patches of a thin-bedded, fine-grained limestone, containing but few fossils.

In the Morris boring the Trenton limestone is two hundred feet thick.

St. Peters Sandstone.—This rock has been struck at the railroad station in Morris, at a depth of about three hundred and seventy feet, and here, as elsewhere in this region, has furnished a constant and abundant supply of artesian water.

Economical Geology.

Under this head we have to consider coal, potter's clay, brick, building stone, lime, hydraulic lime, iron ore and water.

Coal, as already stated, underlies fully three-fourths of the county, the seam averaging about three feet except on the borders of the field. It is very largely worked in the immediate neighborhood of Morris, by from twenty-five to thirty shafts—twice as many are now deserted—varying from thirty to sixty feet in depth, and several extensive "strippings." Some of these strippings uncover coal thirty inches thick, which is about the average thickness in this neighborborhood; while others, on the borders of the outcrop, find not more than eighteen inches. West of Nettle creek timber no shafts have been opened, though the seam cannot be, anywhere on this side of the river, more than eighty feet below the level of the canal, and in most places much less than that. A well on Gen. Birney's place,

four miles west of Morris, stopped, at a depth of thirty feet, in soft blue clay shales, apparently only a few feet above the coal.

A smaller cluster of shafts and strippings is found to the south and west of Goose lake, with the average thickness of full thirty inches. At a stripping in the southwest corner of section 12, township 33 north, range 8 east, the bed is locally thickened to over four feet, but contains near its center a heavy band of crystalline carbonate of iron and lime, with much disseminated pyrite. The coal covers the bottom of the south half of Goose lake.

This seam is also worked at Braceville, (section 25, township 32 north, range 8 east,) by a shaft ninety-eight feet deep, and in section 26 of the same township, by a shaft of one hundred and ten feet. At Gardner, (section 4, township 31 north, range 8 east,) it is worked by a shaft one hundred and sixty feet deep. In the southeast corner of this township three or four shafts, of about sixty feet each, work this seam in its usual condition; but one, in the northeast corner of section 25, finds a roof of black slaty shale, with heavy iron-stone concretions covering about three feet of a very pure "block coal," with much mineral charcoal in the partings. Both the coal and the accompanying beds, at the mine on Au Sable creek, closely resemble the conditions found here; and at both points I have been unable to decide whether they represent a local change in the main seam or are portions of a lower seam which is only occasionally present. I at present favor the former view.

The upper seams, which have been worked upon the Waupecan creek and upon the Mazon, near the mouth of Johnny run, apparently occur over only small areas at either locality; and elsewhere, whenever met with, they have proved to be irregular seams, locally quite thick, but often running out to a mere streak of coaly matter, and even disappearing altogether. It is probable that the Waupecan bed is nearly exhausted, but other portions of the seam will probably be found farther southward, if borings or shafts should be sunk. The Mazon seam is, apparently, the equivalent of a seam which, on the eastern side of the coal-field, in the Wabash valley, is usually too thin to work, except at a single point, where it reaches twenty-two inches. Still, as it lies near the surface and is reputed to be good fuel, it will probably be mined, to some extent, as population increases in that part of the county.

The outcrops are not sufficient to give any exact data as to the dips, but I see no reason to believe that the main seam lies at a greater depth than two hundred and fifty feet in any part of the county, and I doubt whether it is anywhere so deep as that. When-

ever, therefore, any portion of the southern part of the county becomes so thickly settled as to create any considerable demand for coal, it can be obtained on the spot without much difficulty. This seam is of pretty constant thickness at every point where it has been opened, and the miner can rely upon finding a paying thickness of coal at almost any point in this part of the county, even if he sinks his shaft without the usual preliminary boring. At many points, also, one or more of the upper seams would be found much nearer the surface, with from two to nine feet of coal.

In the openings of this county, as elsewhere, the miner is often troubled with "faults" and "rolls," which interrupt the regularity and even the continuity of the seam. Upon the outer edge of the field, near Morris and to the eastward, the dip of the seam is very variable and irregular, which greatly interferes with the drainage of the mines in many cases. Much of this seems to have resulted from the irregularity of the denuded surface of the Silurian rocks upon which the coal was deposited; but, in one or two cases, I have been led to consider the contortions as the result of the removal of the subjacent limestone by solution in subterranean streams after the deposition of the coal. This is the only solution which I can devise for the reported condition of the seam in a shaft a short distance east of the Jugtown pottery. In this neighborhood the seam is generally about twenty feet below the surface, but, in the shaft referred to, it was found forty feet down, and after yielding about three hundred bushels the coal ceased abruptly on all sides.

So far as known, all the coal mined in the county contains more or less pyrite—"sulphur," of the miners—and streaks of calcite; but this is so variable, even in neighboring portions of the same mine, that it would be useless to attempt to discriminate between the products of the different shafts. "Stripped" coal is always inferior to that from a shaft of considerable depth, from its greater exposure to atmospheric and aqueous influences. As a whole, the product of the main seam is a fine steam and grate coal, and is largely shipped to the Chicago market, the distance being only sixty-two miles. The Waupecan coal, not now mined, is said to have made much less "clinker" than the lower seam, but its yield of ash was very much greater, being from six to eight per cent., while that of the lower seam is from one to three per cent.

Brick.—There are several large brick-yards near Morris, which manufacture brick from the decomposed shales which overlie the lower coal. As these beds contain considerable calcareous matter the brick are not very firm and do not stand the weather well. It

would appear probable that the fire-clay below the coal would make a better article. This has not been tried at Morris, but at the Gardner coal shaft the manufacture has been recently commenced. The fire-clay and soft shales underlying it are said to be thirty-five feet deep, and so much of these beds as may be convenient in mining the coal is dug out and used promiscuously. Without thorough grinding, therefore, in the pug-mill, the bricks are variable in character and irregular in burning.

Potters' Clay.—The only bed known and worked is that previously noticed as occurring near the west end of Goose lake, and extensively used at Jugtown in the manufacture of a good grade of domestic earthen-ware, together with drain-tile and sewer-pipes. The bed consists of a more or less thoroughly decomposed clay shale and fire-clay of the Coal Measures, containing many fragments of coal, thoroughly mingled, and deposited in a low part of the old river channel, which contains Goose lake, by the current of the river which formerly flowed there. The mixed character of the materials has given much trouble to the potters. The bed has been worked to a depth of about fifteen feet.

Building Stone.—The only considerable source of building stone in this county is Water's quarry of Trenton limestone, in Saratoga, about four miles northeast of Morris. This yields an abundance of a light-gray or drab, massive limestone, which has been extensively used for foundation walls, and in a few cases also for the superstructures. It appears fitted to stand the weather as well as any ordinary stone. It is said to dress well.

The Cincinnati group, along the Au Sable creek, near the county line, yields small quantities of stone for wells and foundations, but nothing suitable for superstructures. Beds of the same group upon the northern side of Goose lake, have been quarried slightly, for similar purposes.

Upon the bank of Waupecan creek, in the southeast quarter of section 18, township 33 north, range 7 east, Mr. Starr has quarried small quantities of a very solid limestone, No. 6, of the Waupecan section, as given above.

A sandstone, representing Nos. 1 and 3 of the same section, has been quarried to some extent for foundations, on the upper part of the stream, at Hog-grove quarry, and has given good satisfaction; though where exposed to the weather, it crumbles rapidly. The same defect exists in the sandstone of Pine Bluff.

All deficiencies in this respect, however, can be readily supplied from the neighboring quarries of Joliet.

Lime.—The limestone of Water's quarry is burned for lime in large quantities, and is said to furnish a very good article, though care must be taken to exclude from the kiln the more ferruginous layers.

Hydraulic Lime.—The only hydraulic limestone found in the county occurs in nodules along the Kankakee, and in very small quantity. The abundant supply of this material from LaSalle county makes these deposits valueless.

Builders' Sand can be obtained in limitless quantities from the sand ridges of the river valley. From one of these ridges, about one mile south of Morris, large quantities of *road gravel* are also obtained.

Iron Ore.—The ironstone nodules (carbonate of iron) of the Mazon and Waupecan, are not sufficiently abundant to supply a furnace; and the bog-ore noticed near Water's limestone quarry has not yet been tested for either quantity or quality.

Water.—In a dry season, large portions of this county are very scantily supplied with water. In ordinary seasons, wells running ten or fifteen feet into the top of the Drift, supply all needs; but in the western part of the county, reliable wells can be obtained only by passing through the boulder clay to the underlying quicksand. The lower seam of coal is everywhere accompanied by an abundance of water, which is pure and good, until the working of the coal exposes the accompanying pyrite to decomposition. A well recently bored at the tile factory in Jugtown, struck the coal at about thirty feet, and gave exit to a strong stream of water highly charged with sulphuretted hydrogen. Small springs of similar character are said to accompany the supposed line of outcrop of this coal seam, along the foot of the first terrace, from Mazon creek nearly to the Morris bridge. A very strong spring of this character flows from beneath the Drift gravel, over the black shale, No. 3, of the Upper Mazon section, in the southwest quarter of section 6, township 32 north, range 8 east, leaving a heavy white deposit of sulphur on the surface of the shale.

The artesian boring of Mr. Samuel Holderman, on the northeast quarter of section 3, township 33 north, range 8 east, brings to the surface a small but constant supply of slightly sulphurous water from the upper part of the Trenton limestone, at a depth of about one hundred and thirty-seven feet. Mr. John Holderman's well, on section 18 of the same township, has met with no flowing water at

three hundred and twenty-five feet, after penetrating one hundred and eighty-five feet of Trenton limestone. The more recent successful boring at Morris shows that this limestone is two hundred feet thick, and that in this county, as well as in LaSalle, to the west, and Will, to the east, the underlying St. Peters sandstone is full of pure water, which is ready to flow to the surface wherever it is tapped. This abundant supply can be reached anywhere in the northern part of the county at about four hundred feet, and in the southern part at probably nowhere more than six hundred feet, and in part of it much less than that. Any one boring for this in the prairie, where drainage cannot readily be had in every direction, should be careful to so locate his well as to avoid the fate of certain residents of Iroquois county, who have allowed the surplus water of their wells to saturate the soil of their orchards, and so drown their trees.

"Gas" wells in the boulder clay are known in two localities. Near the northeast corner of section 3, township 32 north, range 6 east, Mr. Whitton's well, at twenty feet, gave off so much carbonic acid as to prevent farther excavations. Probably this flowed from some ancient soil, like the muck beds encountered in Livingston, Champaign and McLean counties. On section 35, township 34 north, range 6 east, Mr. Cassel's well, at forty-seven feet, gave off light carburretted hydrogen with so much noise as to be heard at a considerable distance, and in such quantity as to blaze "as high as the house," for some fifteen minutes after being approached with a lighted candle. The gas still flows freely, though it is several years since the well was dug, and a wagon-load of gravel has been thrown in to act as a filter for the water, which was at first filled with quicksand, brought up by the ebullition of the gas. Similar phenomena have been observed in wells recently dug, about half a mile farther south. Near the south line of section 22, in the same township, on land of Mr. Samuel Hodge, is a large spring which constantly gives off bubbles of this gas. Springs of this character have been found, by Capt. H. C. Freeman, to accompany the outcrop of the lower seam of coal in the adjoining part of LaSalle county, and I am inclined to accept them as partially indicating the coal outline here, where the depth of the Drift prevents actual observation of its position.

CHAPTER XXIV.

WILL COUNTY.

Will county is bounded on the north by Cook, on the west by Kendall and Grundy, on the south by Kankakee, and on the east by Kankakee and Cook counties and the State of Indiana. Its form is very irregular, its length, from north to south, varying from twelve to thirty-six miles, and its breadth from twelve to nearly thirty miles. It includes twenty-three entire townships, and two fractional townships along the State line, the whole amounting to something over eight hundred and forty square miles.

This county probably exhibits as great a variety of soil and surface as any portion of the State of equal extent. Through its western half flow the DesPlaines and DuPage rivers, with wide bottoms, subject to annual overflows, and underlaid at no great depth, through nearly their whole extent, with beds of limestone, which two causes combine to make these bottoms exceedingly fertile, wherever the soil is deep enough to give holding-ground for crops.

The banks of these rivers, with those of the Kankakee, which flows through the southern part of the county, being largely composed of decayed limestone ledges and banks of limestone gravel, furnish many fine localities for the cultivation of the grape and other fruits; Messrs. J. H. Daniels, R. H. Waterman, and others, are already engaged in grape culture, near Wilmington, with very flattering success.

The eastern part of the county is mostly rolling prairie, with some considerable stretches of small timber in its northern portion, where the high land of this part of the county begins to slope off toward Lake Michigan. The ridges are mainly composed of sand and gravel, which give good drainage to the comparatively thin covering of brown loam, and favors wheat and other small grains, while the

intermediate stretches of lower ground possess a heavy black mucky soil, underlaid by clay, and produce heavy crops of corn.

The southwestern corner of the county, below the Kankakee, is a broad level prairie, being the northern extremity of Grand Prairie, and possesses the usual heavy, rich, black muck, which produces such immense crops of corn. Considerable portions of this, however, are occupied by coal miners, this being the nearest source of supply for the Chicago coal market.

Throughout the valley of the DesPlaines, DuPage and Kankakee rivers, the alluvial deposits constantly remind the observer that this county once bordered the lower end and outlet of Lake Michigan. The "mounds" along the DesPlaines, which were formerly attributed to the industry of the aboriginal "Mound Builders," are evidently the islands and banks of the old western outlet; while the sandy ridges of the Kankakee valley, apparently identical in structure and in timber overgrowth with those now formed and forming on the shores of the present lake, tell us of the former existence of either an eastern outlet, by the way of either Deep creek or Salt creek (in Indiana), and the Kankakee, or perhaps, more probably, a lake-like expansion of the Kankakee before it cut down through the heavy-bedded Niagara limestone and the underlying shaly calcareous sandstones of the Cincinnati group, which form the high bluff banks of this river along its course through this county. These sand ridges have been traced on the southern side of the Kankakee as far as the mouth of Yellow river, in Stark county, Indiana, and at frequent intervals on the north side of it. Further remarks upon this subject will be found in the report upon Kankakee county.

Among the alluvial deposits of the DesPlaines valley Mount Joliet claims especial attention, from the fact that it has been made notorious by those early writers who supposed it to be the work of the "Mound Builders," who preceded the Indians in the occupancy of the country, and also because the bed of clay at its base is now made of considerable economical value in the production of brick. This bed is a light-drab homogeneous clay, from seven to eight feet thick, of either river or lake origin, and is overlaid by from twenty to thirty feet of a limestone gravel, formed from the outcrops of Niagara limestone, which is continuous for several miles above this point. This is probably only a remnant of a bed which formerly filled the whole valley, and was cut away again by river action before the waters of Lake Michigan were turned from their ancient outlet.

As subsequent in age to this river and lake alluvium, we may here refer to the large boulders which are so abundantly distributed over the broad levels which cap the first terrace in the southwestern part of the county. The majority of them are composed of "greenstone," or "trap," probably from the Lake Superior region, while the remainder furnish representatives of nearly all the varieties of metamorphic rocks. From their position above the black soil it is evident that they floated to their present position on fields of ice, not long before the river retired to its present lower level. They are especially abundant at points where the surface configuration shows that eddies would be likely to form, which would retain the ice-floes until they had time to melt and drop the boulders of rock which they had brought from more northern regions.

Of the Drift proper we see but little, since the alluvium covers so large a portion of the surface. The boulder clay, however, with occasionally a patch of conglomerated sand and pebbles, shows along the Kankakee for two or three miles below Wilmington, and the same beds are often met with in deep wells in the eastern part of the county, and also in the northwestern townships above the DuPage.

The gravel-bed above the boulder-clay is, at some points, more or less compacted by a ferruginous cement, so as to form quite a solid conglomerate. The most notable instance of this is at "Knowlton's Mound," about a mile east of Joliet, along the Cut-off Railroad, where huge masses of the conglomerate lie about in every direction, the looser and finer underlying beds having been shipped to Chicago for street improvement. Traces of iron, in the water which leaches through the overlying soil and clay, give to the gravel a cementing quality so that it packs very finely in the roadway, and after a few months' use can hardly be broken up with a pick. C. Knowlton, Esq., of Joliet, the owner of the mound, informs me that between 30,000 and 40,000 yards of this gravel were delivered in Chicago during the season of 1869, at a cost of over $70,000.

The rock formations of the county are confined to the Coal Measures, the Niagara limestone and the Cincinnati group.

Coal Measures.—The rocks of the Coal Measures cover something less than two townships in the southwestern corner of the county. They consist mainly of fine-grained sandstones, clay shales and fireclays, accompanied by one or possibly two seams of coal.

The outcrop enters the county near the mouth of the DesPlaines river, includes a few sections about the junction of the DesPlaines and the Kankakee, passes south of the latter river below the feeder-

dam, crosses the center of section 8, the west half of section 17, the northwest corner of section 20, the east halves of sections 19 and 30, the north halves of sections 32 and 33, and the west half of section 34, of township 33 north, range 9 east, and through the west half of section 3, the east half of section 9, the west half of section 16, the east halves of sections 20, 29 and 32, of township 32 north, range 9 east, to the southern line of the county.

Two seams of coal appear to exist in this county, viz: that worked at the Schoonmaker shaft, in section 7 of Wilmington township, and the main seam of all this region, which is worked at all the other mines, and is equivalent to No. 2 of the general section of the coals of the Illinois valley.

The Schoonmaker coal is locally ten and a half feet thick, and at no place in the workings is it less than eight feet thick. So far as known, it is overlaid directly by brown and drab alluvial clays; and, to supply the deficiency of roof rock, the upper layers of the coal are left in place, the workings nowhere much exceeding six feet in height. The upper and lower benches are of clean cubical coal, while the central portion has a very irregular fracture and powders readily. As a whole, the coal is impure, containing disseminated pyrite and partings of calcite, and yielding a very large proportion of ash. Certain portions of the bed are quite free from all these objections; but here, as elsewhere, no pains has ever been taken to separate the good from the bad, and the mine has consequently a bad reputation, though what is dug still finds a ready market. The floor of this mine is composed of from four to six inches of fire-clay, resting upon a thin-bedded, fissile, carbonaceous, micaceous sandstone, which has been penetrated to the depth of four or five feet in the sump.

This seam is evidently the equivalent and continuation of the ten-inch seam of coal, accompanied by from eight to ten feet of coaly shale and shaly sandstone, which outcrops on the bluff of the Kankakee, about one and a half miles northwest of the mine, in the edge of Grundy county. Above the mine, in section 8 of the same township, this seam has been worked in the bed of the river, and is said to be from three to four feet thick, with a floor of a few inches of fire-clay, resting upon the lowest beds of the Niagara limestone. The coal is here, of course, greatly deteriorated by exposure; but it is considerably used by the neighboring farmers. This was the first coal known in all this region, and has been worked more or less since a very early date in the settlement of the country. At Schoonmaker's ford, on the county line, this seam is recognized in a band

of rotten coaly shale at the top of the bluff, and is underlaid by from fifteen to twenty feet of ferruginous and micaceous shaly sandstone, accompanied by concretionary nodules, which sometimes contain fragmentary remains of *Lepidodendron* and other plants. A short distance below the ford we find this sandstone resting upon a few feet of olive and ash-colored shales, which, in turn, rest upon the shaly limestones of the Cincinnati group. Where this seam has been worked in the bed of the river, four or five feet of blue clay shale, with fossil ferns, have been reported as resting upon it, in some cases; but below the county line it is overlaid only by a thin bed of purplish shaly clay, entirely destitute of fossils.

The extent of this bed is supposed to be very limited, as borings made within a half a mile of the shaft, on the southward and eastward, have failed to find it or its equivalent, while there is reason to believe that it does not extend far north of the river. The underlying shaly sandstone has been met with in small patches as far north as the southwest quarter of section 21, township 34 north, range 9 east, but unaccompanied by any indication of coal. Along the DesPlaines, below this point, the sandstone lies partly upon the bottom beds of the Niagara limestone, partly upon the green shales at the top of the Cincinnati group. It here contains some remains of trees, one of which, forty or fifty feet long, has been mentioned by Schoonmaker as a tree of "black walnut," which, in color, it very much resembles.

Above the feeder-dam on the Kankakee, coal is said to have been found in the bed of the river, opposite the mouth of Prairie creek; but at Mr. Mellai's place, on the opposite bank, the bluff is composed of dark-colored shales, partly sandy, partly calcareous, belonging to the Cincinnati group, between which and the Niagara limestone, quarried on the other bank, there is certainly no place for any *regular* deposit of coal.

As I have been unable to connect the foregoing section with any outcrop whose position is known, and in the absence of characteristic fossils, I cannot determine with certainty its relation to the other Coal Measure rocks of this county, but it probably belongs below them, and its equivalent should be found by boring below the level of the main seam at points further south. However, as the seam is so variable within the small space over which we have recognized it, there would be no certainty, in fact very little probability, of its yielding any paying quantity of coal at any given locality. I cannot, therefore, encourage the hopes which some persons entertain,

of finding another seam of coal, by boring in the bottom of the present workings, while, at the same time, I would not deny the *possibility* of finding such.

On the other hand, as I believe that no borings have been made on the west side of this mine, between it and the strippings southeast of Goose lake, the coal at which latter point unquestionably belongs to the main seam, although its characters are very unusual, I cannot *assert* that this is not also a continuation of the same seam, which owes its irregularities to its position upon the extreme border of the basin.

The southwest corner of this county is full of shafts, varying from twenty to seventy feet in depth, by which the main seam of coal is reached, and from which hundreds of thousands of tons of coal are annually sent to market.

This seam varies from two feet ten inches to four feet in thickness, and possesses various characters, according to location. Some portions yield a very pure coal, fit for blacksmithing, while others yield a very impure article, containing much pyrite and flakes of calcite. Some parts contain these impurities disseminated in small particles through the whole mass; and in others we find them concentrated in certain benches of the seam, or even compacted into one or more thin bands, which can readily be removed in mining. As a whole, this seam yields a good coal for steam purposes.

Lying so near the border of the basin, this seam, as well as the one previously treated of, has suffered more or less from local displacement, besides having been deposited upon a surface originally irregular. This has been the principal cause of its irregular thickness, and, to some extent, that of its variable character. Where the bed lies upon a sloping floor a large part of the impurities, especially the sulphuret of iron (pyrite), seems to have settled away by gravity and to have accumulated in the lower portions, leaving the upper part comparatively pure.

This irregularity of bottom prevents any regularity in the depth of shafts, and so prevents any accurate estimate of the dip, the general direction of which is toward the southwest. It also prevents any certainty as to the exact line of outcrop; since, from it, we may reasonably predicate the probable existence of outlying patches, separated from the main bed by portions of barren strata. Such will probably be found when more borings shall be made beyond what is now accounted the boundary of the coal area. These patches, however, are likely to be small, and would not warrant any

great outlay in searching for them, especially while so large a portion of territory known to be underlaid by coal remains undeveloped.

So far as yet indicated by borings, the outcrop of this is essentially as follows: Entering the county near the northwest corner of section 30, township 33 north, range 9 east, it passes diagonally to the centre of the south line of this section; thence to the middle of the east line of the northeast quarter of section 31, and eastward to the same point in section 33; thence diagonally to the centre of the north line of the northwest quarter of section 3, township 32; thence southwest to the centre of the west line of the same section, and to the centre of the south line of section 4; thence to the southwest corner of section 9, and in nearly the same course to the centre of section 20; thence due south into Kankakee county. The last three or four miles of this line are determined with less accuracy than the upper portion, since fewer borings have been made in that part of the county.

To the eastward of this line of outcrop borers have often been encouraged by finding beds of soft clay shale—"soapstone"—corresponding in general character with that which overlies the coal; but, so far as I can learn, none of those lower beds contain any of the nodules of carbonate of iron, often containing vegetable or animal remains which characterize ten or fifteen feet of the shale immediately on top of the coal, and, in many cases at least, they probably belong to the underlying Cincinnati group, the Niagara limestone being absent from this part of the county.

The overlying shales are of very variable thickness, and are often accompanied by bands, and occasionally by thick beds of sandstone. I am indebted to Mr. Andrew Binney, of Braidwood, for the following section of the Eagle shaft, on the southeast quarter of section 8, township 32 north, range 9 east:

	Feet.	In.
Soil and drift	22	6
Sandstone—water-bearing	24	
Clay shale—"soapstone"	27	6
Coal	2 ft. 10 in. to 3	10
Fire-clay	7 to 8	
Coarse, porous, water-bearing sandstone	12	
Fire-clay	3	
Coarse sandstone	6	
Greenish fire-clay	15	

The section below the coal was obtained while boring in search of another seam. I have suspected that the "greenish fire-clay" at the foot of the section may be the green shaly clay of the Cincinnati group, but have, at present, no means of deciding the matter.

From other deep borings in this district, I have been unable to get any accurate measurements. I understand, however, that at Keeversville, on the west half of section 5, in the same township, several openings have found a portion of the main seam, varying from six inches to two feet in thickness, separated from its lower side by from eight to twelve feet of fire-clay, and itself still overlaid by fire-clay. At Cadysville, in the east half of section 5, Mr. Wm. Hennebury has bored, and reports the seam split into two or three portions, each of workable thickness. A company of miners was preparing to sink a shaft at this point in the fall of 1868. I have not been able to learn what success they had.

The soft, shaly sandstones along the Kankakee, above Wilmington, which have been supposed to belong to the Coal Measures, are really part of the Cincinnati group, and will be noticed under that head.

Niagara Limestone.—The lower Carboniferous and Devonian rocks being entirely wanting in this part of the State, we find the Niagara group appearing next in order. The limestones of this group underlie fully four-fifths of the area of the county, but the outcrops are somewhat limited, in consequence of the great extent of the Alluvial and Drift deposits. It is difficult to form any very accurate estimate of the beds exposed, because the outcrops are so disconnected; but it probably does not much exceed two hundred feet.

I choose to consider as the uppermost beds those thin-bedded but compact layers which are slightly exposed near the centre of the south half and on the west line of section 13, and in the southwest quarter of section 15, township 35 north, range 11 east. The outcrop at these points is inconspicuous, and has never been developed. It could probably be made to yield a sufficient supply for all local purposes.

Probably near the same level, possibly a little higher, belong the loose, vesicular layers in the bed-rock of the creek, at the northeast corner of section 8, township 34 north, range 11 east. The rock is not such as to invite quarrymen, but a local supply for fences, wells and underpinning can be drawn from near the west line of section 19 of this township and the southeast corner of section 13, in the adjoining township; and more extensive quarrying in the low ground would, undoubtedly, develop beds of fair building stone. At present this is hauled either from the Jackson quarries, near the centre of section 15, township 34 north, range 10 east, or from those at Joliet.

The beds which form the bluffs on both sides of the DesPlaines, at and near Lockport, belong at and below this level. Opposite Lockport the bluff shows, at intervals, from fifty to sixty feet of these beds, which are mostly thin and more or less vesicular, containing imperfect impressions of fossils. The upper part of these beds is passed over in going east from Lockport, and the fragments loose in the soil indicate that they lie not far below the surface; but the only outcrop seen is in the bed of a small stream near the southwest corner of section 2, township 36 north, range 11 east. At several points these beds are used for lime, and yield a very fair article. The lower part of these beds contain several layers of chert nodules, often accompanied by a chalky substance. (Messrs. A. HYATT and E. BICKNELL, of the Peabody Academy of Science, Salem, Mass., have, at my request, examined portions of these cherts, microscopically, but have not, as yet, succeeded in finding any organisms except sponge-spicula.) These flinty layers form a ready means of determining a general equivalence of level, though they extend through a considerable thickness of rock, which varies in amount at different localities. I considered them sufficient, however, to synchronize with these beds those that are quarried extensively in the southeast quarter of section 2 and the northeast quarter of section 11, township 36 north, range 9 east. Here I include, also, the beds quarried to some extent in the southwest quarter of section 26 and the northwest quarter of section 35, township 37 north, range 9 east.

The top of the quarry, in the southeast quarter of section 11 of the last named township, belongs at the bottom of the foregoing beds, while the lower part of it reaches the solid blue quarry rock which lies next below. Some thin beds of this rock have been quarried to a small extent in the southwest quarter of sectton 31, township 36 north, range 10 east. Its lower portion underlies the DesPlaines valley from the county line to below Lockport, and furnishes the quarries so extensively worked between Lockport and Joliet. The Jackson quarries, before mentioned, are at nearly the same level. These beds are also extensively quarried in "Twelve-mile Grove," near the center of section 10, township 33 north, range 11 east, and the lower part of the bed is seen in the bottom of Forked creek, in the southwest corner of section 21 of the same township. The rock of this division is a hard, fine-grained compact limestone, with comparatively few fossils, though some of the beds furnish fine large specimens of *Orthoceras*, *Cyrtoceras*, etc. In these beds, also, we frequently find layers filled with the wood-like markings known

as lignites or stylolites. Through the whole of this division we find more or less partings of greenish clay, which, upon long exposure, ultimately develop seams, even in those beds which, when freshly quarried, appear most solid. The amount of this material increases rapidly as we approach the base of this group in its southern extension, indicating that the conditions which produced a deposit of from forty to fifty feet of it in the Cincinnati epoch continued, though with less intensity, long after the introduction of the fauna which characterized the Niagara period.

The bottom division of this group contains beds of very various characters. Near Grinton's mill the beds are partly cellular, partly quite compact, partly nearly a pure drab limestone, partly a soft buff impure limestone, in character approaching the underlying beds of the Cincinnati group.

At and below Joliet they are nearer the upper beds in material, and furnish some fair building stone, but they are still quite cellular, and contain more of the greenish clay partings. They retain this character, the thin layers becoming more compact in structure, but separating more readily as we pass to the southward of Channahon, and across to the Kankakee. Here they retain their later character until we pass Wilmington, but near the southeast corner of the county they again become more porous and impure. This change of character is noticeable in connection with the fact that, at and near Grinton, these beds rest upon the shaly magnesian limestones of the Cincinnati group, which thin out towards the southwest, and finally disappear entirely, leaving the Niagara beds, from above Wilmington to opposite Channahon, resting directly upon the underlying green shales.

At the mouth of Prairie creek, three miles below Wilmington, one of the lowest beds of this group has furnished large slabs covered with fine specimens of *Pentamerus oblongus*, which is, in New York, characteristic of the Clinton group, but I am unable to distinguish any corresponding division of the rocks in this division.

The *Orthis bilobus* occurs in the corresponding beds near Channahon, and *Stromatopora* and other Niagara corals are not rare in the bottom layers of the quarries east of Wilmington.

As a summary of the rocks of this group, I offer the following general section:

	Feet.
Thin-bedded, coarse, rather vesicular beds	75
Irregularly bedded limestone, with bands of chert	40
Blue quarry stone, weathering buff, heavy-bedded	50
Thin-bedded, compact to porous, parting readily	40

The outline of this group is nearly as follows:

Entering the county near the northwest corner of township 35 north, range 9 east, it runs nearly southeast to near the southeast corner of section 24, and includes the larger part of section 30, township 35 north, range 10 east; here it crosses the DesPlaines, and follows down its south bank, on the top of the bluff, as far as to the center of section 29, township 34 north, range 9 east; here it passes under the shaly sandstone of the Coal Measures for a short distance, and then accompanies their outcrop up the "Cut-off" to the Kankakee, which it follows, with only a slight show upon the south bank, to the mouth of Prairie creek; here it bears more to the eastward, and passes around to the north and east of Wilmington, turning south through section 31, township 33 north, range 10 east, and following the north bank of Forked creek to the middle of section 17, township 32 north, range 10 east; here it crosses and strikes the bank of the Kankakee in section 20, and follows it westward through the county.

Forked creek and its cut-off also inclose an island of this group, which occupies considerable portions of sections 7 and 18, township 32 north, range 10 east. This group also appears upon the south bank of the river for about a mile below the county line.

The general dip of the beds is toward the northeast, but there are everywhere so great local variations, both in direction and amount, that any attempt to indicate them by figures would be fruitless. This has probably resulted, at least in part, from the softness of the underlying beds.

Cincinnati Group.—The rocks of this group, in Will county, consist of buff shaly argillaceous and magnesian limestone, with pyrites and some chert, a heavy bed of green shaly clay, and blue shaly limestones with some petroleum.

The bottom beds at Grinton's mill probably belong to this group, but at this locality the lower beds of the Niagara approach so closely in character to the upper beds of this group, that it is very difficult to mark the division with certainty. One mile down DuPage, however, in the southwest quarter of section 16, township 35 north, range 9 east, there is an outcrop of undoubted Cincinnati group. The beds here are light-buff porous magnesian limestones, with bands of chert nodules. A small *Loxonema* in the chert was the only fossil observed. The section exposed is from twelve to fifteen feet thick. Near the center of the north half of section 5, township 34 north, range 9 east, from eight to ten feet of thin-bedded buff limestone, with sandy partings, probably corresponding with the lower part of the above

section, have been quarried to a small extent in a hillside. A half mile east of this, in the south half of section 33, township 35 north, range 9 east, from eight to ten feet of thin-bedded argillaceous limestone, with many of the common fossils of this group, form the low bank of the DuPage. These beds underlie those before mentioned, and are probably equivalent to the middle of the Rock Run section.

At the mouth of Rock run, near the east line of section 35, township 35 north, range 9 east, considerable stone has been quarried for local use. It is a thin-bedded, very argillaceous limestone, originally blue, but weathering first rusty and then light-drab, with bands of chert near the top of the quarry, and more or less pyrites scattered through the whole mass. Fossils are abundant, but rather fragmentary, including *Orthocerata*, various brachiopods, a few trilobites, and some fucoidal markings. The thickness exposed is nearly forty feet.

Near the bridge over the DesPlaines, in the northeast quarter of section 21, township 34 north, range 9 east, we find these beds of limestone thinned out to about ten feet, between the Niagara limestone and the underlying green shale. They here contain an abundance of *Petraia* and *Orthis*, with an occasional *Calymene* and one or two other forms. No equivalent of these beds has been found upon the Kankakee, though it may possibly be represented among the buff limestones of this group, near the southeast corner of the county.

The bed of green shaly clay which forms the middle division of this group in this county is a perfectly homogeneous fine-grained clay, with no fossils and no impurities of any kind so far as observed. Along the Des Plaines, through the east half of township 34 north, range 9 east, this bed is known to be from forty-five to fifty feet in thickness, and it is not less than that on the Kankakee, where it is first observed just above the mouth of Prairie creek, on the north bank, and thence accompanies the outcrop of the overlying Niagara rocks up the river to near the county line, where it dips below the water level. Above Wilmington, it becomes more impure and somewhat thinner.

Below this bed, along the Kankakee, especially near and on the banks of Horse creek, there is a considerable outcrop of about fifty feet of drab and greenish shaly sandstones, rather irregularly-bedded, and showing fucoidal markings. The same beds, of a locally different character, are exposed for a short distance along the south bank of the Kankakee, opposite the mouth of Prairie creek. From near the

top of this bed a boring has been made at Mr. Johnson's place, on section 13, township 32 north, range 10 east, of which the following is the reported section:

	Feet.	In.
1. Shaly sandstone	50	
2. Soft clay shale (soapstone)	30	
3. Flinty sandstone	5	6
4. Blue "soapstone"	24	6
5. Hard drab clay shale	6	

The "soapstone" No. 2 of this section outcrops along the river bank, about two miles above Wilmington, and, from its close resemblance to the blue shale above the main coal seam, has misled many persons into the belief that the coal could be found farther east. It was only after repeated examinations that I became satisfied of its true position.

The "flinty sandstone," No. 3, is probably the representative of the compact fragmentary clinking limestone which shows a much greater thickness at its outcrop near Wilmington. This lower division of the group there consists of light-blue shaly limestones, with occasional bands of these compact layers, fitted for under-pinnings, but rarely furnishing material suitable for superstructures. Its outcrop is very limited, being confined to the bottoms of the Kankakee, between the mouth of Forked creek and the ford near the north line of section 12, township 32 north, range 9 east, and the banks of Forked creek below the "county road" running east from Wilmington. Over all this outcrop the beds are crowded with the ordinary fossils of the group, such as *Rhynchonella ˙copax, R. hemiplicata, Orthis lynx, O. subquadrata, Leptæna sericea, Strophomena alternata, Orthocerata, Tentaculites,* corals, bryoza and crinoidal fragments, with occasionally fine fragments of trilobites.

A boring upon the island, at Wilmington, gave the following section:

	Feet.
Blue shaly limestone	15
Hard, gritty rock, in thin layers	15
Dark clay shale, with pockets of petroleum	70

Petroleum is also found filling cavities in the overlying beds of more compact limestone, which outcrop farther up the river, and add probably twenty-five or thirty feet to the foregoing section. These beds also frequently contain cavities lined with very pretty crystals of the "dog-tooth spar" variety of calcite. The limestone itself is composed of comminuted shells and crinoids, and yields few fossils in good condition.

Mr. Jason Franklin reports the following as the section found in his "oil-well," in the south half of section 23, township 32 north, range 10 east:

	Feet.
Sandstone	15
Clay shale, with harder bands	115
Yellow and white sandstone	5
Blue sandstone	100
Blue sandstone, with pyrite	38

As no beds of sandstone are found elsewhere to correspond with the lower beds of this section, and as the upper fifteen feet are evidently the rotten beds of magnesian limestone which form the base of the Niagara group in this region, I am disposed to believe that the lower beds are also limestone. If this is true, the one hundred and fifteen feet of "clay shale, with harder bands," will correspond with the two upper divisions of the Cincinnati group, as above given; the one hundred and five feet of "sandstones," the lower division of this group, and the thirty-eight feet of pyritous rock may represent the compact drab limestone, sometimes pyritous, of the Trenton group, the top layers of which are quarried in Saratoga, four miles northeast of Morris, in Grundy county. The whole section, however, is liable to error, having been made by an inexperienced borer. I give it as the only indication, however imperfect, of the underlying beds in this part of the county, with the exception of Mr. Johnson's boring, before given, which did not reach so great a depth.

SUMMARY.

The following is an approximate estimate of the total thickness of rock exposed and explored within the county:

	Feet.
Alluvial and Drift clays and gravels	100 to 150
Coal Measure sandstones and shales	100 to 125
Niagara group limestones	200
Cincinnati group limestones, shales and clays	220 to 260
Trenton group limestones	38?

Economical Geology.

Among the mineral resources of Will county, the first place is naturally given to

Coal.—Though the outcrop of the Coal Measures covers but a very small part of the area of this county, yet the amount of coal mined therefrom is very large.

Analyses of a few coals from this county were made some years since, and were published in the first volume of these reports. Since fuller examinations of the territory have shown the great variations in the character of the coal within short distances, a phenomenon which usually accompanies outcrops so near the edge of the basin, it has not been thought best to make any further examinations of this sort. Throwing out the more noticeable impurities, such as the nodules and layers of pyrite or "sulphur," and the occasional bands of slaty clay, the mass of the coal makes a very good article for steam purposes, and some portions furnish a good blacksmithing coal; but no considerable quantity is found that appears suitable for smelting purposes.

Assuming the coal area in this county to be about twenty square miles, and allowing to the seam an average thickness of three feet three inches, the usual rule of estimate would give 66,000,000 tons as the amount accessible within the county.

Building Stone.—The quarries of Joliet and Lockport make no insignificant figure in an estimate of the resources of Will county. The amount of stone accessible here is almost unlimited. Only from twelve to fifteen feet of beds furnishing "dimension stone" are now quarried, as the bottom of this brings the quarrymen down to the water level, and the supply has thus far been so abundant as to make deeper explorations unnecessary. Above the layers which are quarried, there are several feet of beds, now decayed, which were originally of very nearly the same consistency as the lower ones; and when they shall be worked back into the hill beyond the extent of atmospheric influences, will probably be found equally valuable. The stone itself is a very compact, fine-grained, clinking, magnesian limestone, but thin seams of greenish clay run irregularly through

---

NOTE.—During the summer of 1869, an artesian well was sunk at the Penitentiary, near Joliet, and the following section of the bore has been furnished me, through A. J. MATTHEWSON, Esq., of Lockport:

		Feet.
1.	Rubbish	12
2.	Cherty limestone	16
3.	Soft white granular limestone	60
4.	Coarse rock, resembling Niagara limestone	279
5.	Soft shales and clay	110
6.	Clear sharp sand-rock, full of water	50
	Total	527

It is impossible to make this agree with known outcrops, or with the facts ascertained by borings in adjacent counties. Nowhere in this region, if anywhere, is there such a bed as No. 5 lying upon St. Peters sandstone of No. 6. If Nos. 4 and 5 could be made to exchange places, we might suppose the 279 feet of limestone to represent the lower part of the Cincinnati group and the whole of the Trenton. There is probably error in the record.

the whole mass, which, upon long exposures in situations alternately wet and dry, must ultimately cause the most solid layers to split up, especially when they are set up on edge. The separation in the quarry into "ledges" of ten, twenty-four, thirty, and forty inches in thickness, simply results from the presence of somewhat thicker partings of this same greenish shaly clay. It is not probable that this structure will sensibly affect the stone used in building in ordinary situations, except after the lapse of many years; but care should be taken to reject such portions of the layers as come from very near the outcrop.

These beds were formerly described as composed of light buff stone, while the deeper portions of the quarries now furnish the "blue stone." The difference results from the difference in amount of oxidation of the small portion of iron disseminated through the whole mass, the change having resulted from atmospheric influences. The same change must ultimately take place in all the "blue stone" which is brought to the surface.

The same beds are now quarried at Twelve-mile Grove, in the town of Wallingford, and some fine stone is obtained. Distance from railroad communication alone prevents the development of quarries of equal value with those of Joliet.

The Jackson quarries are also in nearly equivalent beds.

The beds of this portion of the Niagara group, where exposed near the surface for some time, yield flagstones of considerable size; but those of the lower portion of the group are more extensively quarried for this purpose, and have, apparently, a rather larger proportion of the shaly partings. This character alone prevents some portions of these lower beds from equaling the higher ones for building purposes.

From the whole extent of the outcrops of this group, small quantities of stone are quarried for fences and wells, and occasionally for buildings; but no other quarries than those above mentioned have assumed any considerable importance as sources of regular supply. The quarry in the southeast corner of section 11, township 37 north, range 9 east, seems to have reached the solid beds below the cherty layers, and is likely to prove valuable; but, at the time of my visit, it had not been fully tested.

The upper division of the Cincinnati group has been quarried to a small extent for local uses, at the mouth of Rock run, between Joliet and Channahon; but the beds are so shaly as to be readily broken up by the weather, and can never furnish a reliable building stone. The limestone of the lower member of the Cincinnati

group, occasionally quarried in the bed of the Kankakee, between one and two miles above Wilmington, gives small quantities of a permanent but rather rough and irregular stone. It would probably be worth more for lime, if care were taken to exclude the shaly portions of the beds.

Lime is burned at numerous points in this county, the principal production being from the lower portion of the Niagara group. An impure article is also furnished from the shaly limestones of the Cincinnati group, at the mouth of Forked creek in Wilmington. Small quantities of hydraulic cement have been burned from a bluish bed near the base of the Niagara group in the south part of Joliet.

Brick.—With such an abundance of building stone, comparatively few brick are used in the county. The production is principally from the brown clay sub-soil, which is found distributed throughout the timbered portion of the county, and, to some extent, under the prairie soil. A few brick are also made from the alluvial clay of Mount Joliet. The fire clays which underlie the main coal seam, in the southwest corner of the county, are made to yield a good article of brick, at Gardner, in the adjoining part of Grundy; but no use has been made of them in Will county.

Pottery.—At Mount Joliet, large quantities of drain-tile are manufactured from the alluvial clay of the neighborhood. The green shaly clay, which forms the middle division of the Cincinnati group, in the south part of the county, appears well fitted for potter's use, but I cannot learn that any attempts have been made to utilize it. The results of experiments made by the "Mound Company," with the various beds of the neighborhood, are well summarized in the following letter from a son of one of the proprietors, for which I am indebted to our mutual friend, Mr. H. M. Bannister, of the Survey:

Portland, Oct. 6, 1868.

H. M. Bannister, *Assist. Geologist of Illinois*:

Dear Sir:—As regards the Joliet Mound, situated one and a half miles southwest of the City of Joliet: It is about one-fourth of a mile in length, and two to three hundred feet in width. At its northeast extremity is solid limestone rock, overlaid with a thin stratum of blue clay, above which is about twenty feet of fine gravel, containing a large percentage of cement, and many boulders of various sizes and species. The rock dips towards the southwest, and when it reaches the gravel pit, at or near its extreme end, the gravel bed is forty or fifty feet in thickness in the centre, while beneath it is

a bed of fine, blue, earthen clay, six feet in thickness, and remarkably free from stones and other impurities, though strongly impregnated with salts and lime, and so solid as to require a sharp pick to excavate it. The top of the bed is stratified, and colored with oxide of iron, producing a fine slip or glaze for pottery ware. The lower portions of the bed is solid and rather an impure clay. The bed dips with the rock, and increases in thickness in the same proportion as the gravel.

Many Indian remains have been exhumed while excavating the gravel, and an old flint-lock pistol was found ten feet in the gravel, while excavating the clay. I have seen toads jump out of the solid bank and hop off.

Under this bed of clay are boulders, gravel and clay, and under that a stronger brown clay, beneath which are strong evidences of the same formation as that above it, and then rock.

One-half mile further to the southwest is Mount Flat-head, one mile in length, one-quarter in width, and about sixty feet in height, composed of boulders and gravel, with very little cement and no clay under it. The rock in this mound dips in directly the opposite direction from that in Mount Joliet.

The clay used in the manufacture of tile is from a ridge one-quarter of a mile northwest of the mound, and forming one of the boundaries of the DesPlaines valley. It is a red, earthen clay, formed in cubes, strongly impregnated with iron, and a little lime and some fine gravel mixed with it. (I found the same bed at White Lake, Michigan). The bed is ten or fifteen feet thick, and is a good, strong, earthen clay, and can be used as a high-fired slip clay, or a lower fire if a flux be mixed with it. Its formation is very irregular, as is all that region. Under it are fine yellow and blue loams, and under them gravel and boulders and then the rock. Not one hundred feet from this bed is one of brown clay, of great depth and filled with lime pebbles. The internal arrangement of the whole ridge is similar to rolling prairie, and of every species of Drift. Two miles below the mound, in a railroad cut, you will find a bed of hard, stratified or shaly clay, brown, red and green, with which we experimented largely, but it was so full of lime and lime-dogs as to be of very little value, although it stands a heavy fire to a certain point, and then suddenly gives way, and in burning checks badly by fire and air.

All down the DesPlaines valley, on either side, are extensive beds of the same material. At Channahon, on Mr. Althower's place, in his low land, is a bed of fine, greasy, blue clay, which is very good

for a glazing clay, and not far from it is a bed of white marl. On the Rock Island railroad, near Mokena, is a bed of green clay, and you will find pockets of it in the rock at Lockport.

I know very little of the Goose lake clay, save that they have had great trouble with it. At the coal mines at Morris is a species of fire-clay, but we did not think much of what we tested. On the line of the Alton and St. Louis railroad, between Willow Springs and Athens, you will find white fire-sand. There are no valuable clays within sixty miles of Chicago, and not extra brick-clays.

Yours truly, and in haste,

GEO. D. GOODRICH.

Peat has been found in small patches in some of the swampy land near the east line of the county, but no beds of any importance have yet been reported.

Copper.—Nuggets of native copper have been found in the Drift of this county, and have caused occasional excitements over the prospect of finding a copper mine. One was picked up at Lineburger's quarry, near Wilmington, where it had fallen upon and partially sunk into the decomposed green shaly clay of the bottom of the quarry, and "boring for copper" was seriously talked of, but wiser counsel prevailed.

Iron Ore nodules accompany the shales overlying the coal, but no considerable quantities are accessible. A small bed of bog iron ore was noticed near the saw-mill, near the centre of the west line of section 13, township 35 north, range 11 east, but no exploration has been made to ascertain its depth or exact extent. Considerable beds are known to exist in the adjoining parts of Indiana, and all extensive deposits will ultimately become valuable for use, in connection with the more compact and richer ores of Marquette and Missouri.

Water.—Through the eastern part of the county a constant supply of water is not readily accessible, in consequence of the thickness of the deposits of sand and gravel which overlie the boulder clay and form the high, rolling surface characteristic of this region. A few springs reach the surface in the timber, and some of the prairie ponds retain their water through the year; but, in a dry season, there is often much suffering among cattle. So far as I could learn, no wells have been driven through the boulder clay; below it, an unfailing supply could be reached, though, in some places, the depth would forbid attempts to raise it. The three river valleys are mostly well watered by springs flowing from the outcropping edges of the rock strata. All over the DesPlaines bottoms

wells are readily obtained at a small depth in the rock, the water of the river finding ready passage through the numerous crevices and worn passages which are so characteristic of limestones exposed in any degree to water action. The triangle between the DesPlaines and the Kankakee, below the bluffs of the second terrace, which run from opposite Channahon directly toward Wilmington, has comparatively little soil upon the rock, and much of it is entirely destitute of surface water. By penetrating, however, to heavy beds of green shaly clay which underlies it, and is here from forty-five to fifty feet thick, an abundant and never-failing supply can be obtained from the surface of the underlying shaly limestone.

The high ridge of boulder clay and gravel along the western line of the county, above the DesPlaines, has a few wells that do not fail in a dry season. On the eastern slope of that ridge, in section 30 of Plainfield township, as I am informed by Rev. Dr. Clarke, of that town, Deacon Caton bored sixty-one feet through the boulder clay, and got water just after striking the solid rock. I do not know the level of the surface at that point, but judge, from what I know of the levels elsewhere in that region, that this well must have reached as low as the lake level, and perhaps lower.

In the Eagle shaft, at Braidwood station, the coarse sandstones which accompany the Coal Measure shales yield a very large amount of pure water, a four-inch stream flowing constantly from the pumps.

Through the artesian well at Joliet penitentiary, water flows freely from the St. Peters sandstone, which was struck at the depth of four hundred and seventy-seven feet. The following data will be the means of calculating, approximately, the depth of this bed in most parts of the county, assuming that the dip of the sandstone is regular:

	Feet above or below datum.	Depth to sandstone.
Morris—section 4, township 22 north, range 7 east	—56	370
Joliet—section 3, township 35 north, range 10 east	—24	477
Chicago—section 9, township 38 north, range 14 east	plus 21	834

Morris to Joliet, east 30°, north 21 miles.

Morris to Chicago, east 35°, north 51 miles.

Levels of points in Will county, above or below "Datum of six feet below the lowest registered water of Lake Michigan," as furnished by the Illinois River Survey, in charge of Gen. J. H. Wilson, U. S. A.:

	Feet.
DesPlaines river (low water) at county line above Lockport	plus 12.150
" " " at Lemont (Cook county)	plus 13.795
" " " at Lockport	—13.540
" " " below railroad bridge at Joliet	—58.657

	Feet.
Des Plaines river (low water), at mouth of Rock Run	—71.640
" " " under Kankakee feeder aqueduct	—85.268
" " " at junction with Kankakee	—87.809
Bluffs at Lockport, east side, plus 74 09; west side, plus 66.27.	
Bluffs at Lemont, east side, plus 102.00; west side, plus 137.20.	
Kankakee river, (low water) east line Grundy county	—83.110
" " " head of feeder, below State dam	—69.588
" " " head of feeder, above State dam	—69.580
" " " Prairie creek	—58.498
" " " under road bridge at Wilmington	—51.501
" " " above rapids	—39.112
" " " east line of Will county	—27.698
*North of Momence—Kankakee and Will county line	plus 128.578
" " Summit, or dividing ridge	173.206
" " Eagle lake	147.532
" " waters of Plum creek	125.280
" " village of Crete	154.460
" " waters of Thorn creek	125.830
" " village of Bloom (Cook county)—Cut-off railroad	108.550
Illinois Central Railroad—village of Monee	228.000
" " " Cook and Will county line	180.000
" " " line 34 and 33	200.000
" " " line Kankakee and Will counties	103.000
Chicago, Rock Island and Pacific railroad—village of Mokena	142.000
" " " " " DuPage river	—30.000
" " " " " village of Minooka (Grundy county)	plus 35,000

In the survey of this county, I am especially indebted to the kind assistance of A. J. Matthewson, Esq., of Lockport.

*On a rather irregular line, varying from one to two miles, east of west line of township, range 14.

CHAPTER XXV.

KANKAKEE AND IROQUOIS COUNTIES.

Kankakee county is bounded on the north by Will, on the west by Grundy and Livingston, on the south by Ford and Iroquois, and on the east by Lake and Newton counties, of Indiana. It forms nearly a rectangle of twenty miles from north to south, by about thirty-eight from east to west; but two townships of the northwest corner of this rectangle have been assigned to Will county, thus reducing the area of Kankakee county to six hundred and seventy-four square miles.

This area is divided into three unequal portions by the Kankakee and Iroquois rivers, the former of which enters the county near the middle of its eastern side, runs westerly and thence southwesterly to the mouth of the Iroquois near the center of the southern third of the county, and thence northwest to the southwest corner of Rockville township, whence it passes into Grundy county. From near the center of the south line of the county the Iroquois flows in an irregular northerly course to its junction with the Kankakee, just below Aroma. The Kankakee is fordable at numerous points below Momence; but above the dam at that place it is deep and nearly level for some miles beyond the State line, having a fall of from four to six inches to the mile. From Momence to Rockville its fall is one hundred and twenty-seven feet, or above five feet to the mile. Throughout this latter part of its course it has a rock bottom, affording good foundations for dams, whether for utilizing the water power or for purposes of navigation. With this latter point in view the United States government has caused surveys to be made, which have shown that by the construction of a few dams and locks this stream can, at comparatively small expense, be made

navigable from St. Joseph's county, Indiana, to its junction with the Illinois. The Iroquois is rocky and shallow through all of its course within the limits of this county, but from the county line it is deep and still, and is navigable for flatboats nearly or quite to the Indiana line.

Along the latter part of the course of the Kankakee its bottoms are narrow and rocky bluff-banks are quite frequent, but above Aroma the bottoms are much wider, and any rocky banks are of very little height. Over these bottoms are large deposits of sand; and sand ridges from fifteen to thirty feet high form, in many places, the boundaries of the bottoms—that is, the banks of the ancient river valley. Similar banks were traced up the valley of the Iroquois as far as Middleport, in Iroquois county, and are said to form its banks for some miles above the Indiana line. These banks were not carefully examined, for want of time, but I learn that they contain, in many places, numerous shells of *Unio*, *Paludina*, and other forms identical with those now living in the river.

I was formerly inclined to believe that the Kankakee valley was at one time occupied by an outlet of Lake Michigan, which ran from its southern extremity by the valley of either Deep river or Salt creek; but, since I find that the sand ridges are continuous with those which are so largely developed in the upper part of Kankakee valley, and especially since Dr. E. Andrews, the learned President of the Chicago Academy of Science, assures me, from personal observation, that no connection ever existed by Deep river or Salt creek valley, I am compelled to believe that this was a distinct lake basin, twenty-five or thirty miles wide in its upper part, and of as yet undetermined length. The sand ridges, which mark its outlines, have been traced almost continuously from the mouth of Waupecan creek, on the south bank of the Illinois, nearly opposite Morris, in Grundy county, to the mouth of Yellow river, in Stark county, Indiana. I learn from Mr. A. J. Matthewson, of Lockport, who has explored much of the Kankakee valley, that they continue over the divide and connect with the sand ridges of the Wabash valley. This, however, unless the connecting portions are *proved* to have been deposited by water in their present position, would not prove the connection of the waters of the two basins, since the wind often raises, upon lake shores, accumulations of sand to a considerable height above the water level, as at Michigan City, where an elevation of this sort has attained a height of one hundred and seventy-six feet above the lake; and these connecting portions may have had that origin.

Along the Louisville, New Albany and Chicago Railroad, the highest sand beds on the south side of the valley were found at forty-five miles from Michigan City, at an elevation of twenty-five feet above the Kankakee, and one hundred and four feet above Lake Michigan. On the north side of the valley, the highest beds were found at Hog creek, twenty-one miles from Lake Michigan, at about the same level. Above this level, at both points, the gravel beds of the Drift come to the surface, covered only by the soil. Through the eastern part of Iroquois county, Illinois, and the central part of Benton county, Indiana, there is said to be a stream of boulders two miles wide, having a general northwest and southeast direction. Although these must have been dropped from floating ice, at a time when all this country was under water, so that we cannot argue directly from their position with regard to the form of the land at a later period, yet we may fairly infer that whatever channel then existed probably had the aforesaid direction; and, since no such depression appears to exist, or to have existed toward the southwest, it probably did exist to the eastward, and it is not impossible that old Lake Kankakee had its outlet by the Wabash, before its waters began to cut down the rocky barrier through which they have since excavated the deep valley from Aroma to Wilmington.

Though the sand ridges have not been traced to their limit on the upper Iroquois, yet, as the bed of the river at Rensselaer, only sixteen miles from the southernmost sand bed on the L., N. A. and C. railroad, is said to be only thirteen feet higher than the top of that bank, it is evident that the old lake must have nearly surrounded the high land of the southeastern part of Kankakee county and the northwestern part of Iroquois.

The elevation of this peninsula is known to me at only one point,* namely, at Morocco, Newton county, Indiana, which OWEN states to be one hundred and eighty feet above the bed of the Kankakee, at Momence.

The peninsula between old Lake Kankakee and Lake Michigan varies from ten to twenty-five miles in width, and is seventy or eighty miles long. The lowest *measured* point is near Eagle lake, in Will county, Illinois, where Col. WORRALL'S surveying party found an elevation of one hundred and seventy-three feet above the established "datum" of "six feet below the lowest registered water of Lake Michigan." Monee, a few miles west of this point, is two

*The Chicago and Danville Railroad crosses this promontory a short distance west of the State line; but applications for the profile of that road have been unsuccessful.

hundred and twenty-eight feet above "datum," by railroad survey. It is probable that a much lower point exists upon the "divide," somewhere near Deep river or Salt creek, in Lake county, Indiana.

A large sand ridge forms the north shore of Eagle Lake, at an elevation of one hundred and forty-eight feet above "datum;" but this is probably local, and not directly connected with the ridges of the river valley.

Much of all these sand accumulations is nearly pure quartz grain, partly worn and rounded, as if by long wear and travel, while parts are evidently merely the disintegrated sandstones of the Coal Measures, not much changed by friction.

I have been unable to obtain any satisfactory information regarding the character and levels of the country between South Bend and Lake Erie. It seems highly probable that when that lake stood at the level indicated by the highest terrace upon its ancient shores, not far from two hundred and fifty feet above its present level (say eight hundred and fifteen feet above the ocean), it should have had an outlet toward the west, and this must have been either the Kankakee or the Wabash.

The sloughs which lie between the sand ridges of the old valley are filled with soft black muck, which is just the material needed to make these sandy portions exceedingly productive; when drained of the surplus water, they are themselves unsurpassed as corn-land; in their present condition, they would appear to be just the places for the culture of cranberries for the Chicago market.

Upon the bottom of Beaver lake, just east of the State line, since it has been partially drained, skeletons of *Mastodon* and *Bootherium* have been found by Dr. H. M. Keyzer, of Momence, and others; and it is not improbable that remains of these animals will also be found within the limits of Kankakee county.

Drift Formation.—The dryer portions of the county, out of the river valleys, are mostly high, rolling prairie, with a few small groves, which shows but a slight covering of soil and thin clay subsoil above the gravel beds of the Drift. At a moderate depth we find everywhere, with few exceptions, the tough, blue "boulder-clay," which usually has, in this region, a thickness of over one hundred feet.

Whether there was or not an outlet from the south end of Lake Michigan, after the close of the Drift period, there certainly was one at that point before the Drift was deposited. This valley, including that of Lake Michigan, *may* have been excavated by a glacier; but of this we cannot be certain, without a more extended

examination of its bottom than will probably ever be possible. The depth of this channel in its northern part is unknown. Its western bank is seen on the Kankakee, just above Momence, where the rock suddenly breaks off, and probes forced to considerable depths found no solid bottom. These facts were ascertained, in 1867, by Col. JAMES WORRALL, then of the Illinois River Survey, now of Harrisburg, Pa., who also informs me that the same "shoulder" of rock is found upon the Calumet, nearly due north from Momence. In this part of its course, passing through very solid rocks, the channel is rather narrow, rocks having been found upon its east side and south of the Kankakee, within seven miles of Momence; the exact location of its eastern bank is as yet unknown. From this point the course of the channel is not certain, but it *probably* keeps near the State line until it nearly or quite reaches the valley of the Iroquois; then runs westerly to the valley of Spring creek, having a depth of one hundred and sixty feet near Sheldon (as reported by H. S. WING, Esq., of Kankakee City), and then turns south with a depth of two hundred and sixty-eight feet between Onargo and Gilman, of "over three hundred feet" between Onargo and Spring Creek station, and of "over three hundred feet" between Paxton and Rantoul, as reported by JOHN FAULDS, Esq., of Catlin, Vermilion county. As the western bank was found at Chatsworth, Livingston county, with its top eighty-eight feet and its bottom two hundred feet below the surface, thus giving a width of fifteen miles or more, it is evident that the softer materials of the Devonian, lower Carboniferous, and Coal Measure shales and sandstones have afforded less resistance to the denuding agent than the solid Silurian limestones, which confined it to less than seven miles at Momence. Champaign and Onargo, in Champaign county, are located over this old channel, and from one hundred and seventy-five to two hundred and twenty-five feet above its floor, but are probably near its eastern border. Here and at Chatsworth we find, among the Drift beds, a single layer of old mucky soil, with leaves and trunks of trees. At Bloomington, in McLean county, the channel is two hundred and fifty feet deep, and the beds which fill it include two beds of old soil, which I am inclined to accept as indications that this point is near the middle of the old valley, or at least near its principal channel. The route west of Bloomington is unknown.

As the bluffs which bound the DuPage valley, upon the west, are composed entirely of Drift gravel and clay, with a rock foundation nearly on a level with the rock at the head of the Illinois, or about ninety feet below the present level of the lake, while there is an

elevated rock island reaching from there to Momence, it is not impossible that, in that region, also, there was at this same period some outlet for the contents of the basin of Lake Michigan; but no deep, strongly-marked channel is there indicated.

Rock Formations.

Though great quantities of fragments of black shale, with not infrequent rounded lumps of coal, are found in the Alluvial and Drift deposits, and continually excite the imaginations of persons ignorant of geology, no beds of either coal or black shale exist within the county, except on its extreme western border. These fragments are either the remnants of beds which formerly existed here, or, more probably, are remains of the beds which formerly connected the northeastern portion of the Illinois coal field with that of central Michigan, and have drifted hither from the east and north. Much of the black shale, however, probably came from the outcrop of the Devonian (or lower Carboniferous?) bed of that material which outcrops so widely through northern Indiana.

Coal Measures.—As already indicated, the Coal Measures are confined to the extreme western portion of the county. Their eastern boundary enters the county from the north near the centre of section 5, township 31 north, range 9 east, runs due south nearly three miles, then bears a little westward, and near the centre of the west line of township 30 north, passes into Livingston county. Explorations have not yet been made to such an extent as to indicate more exactly the southern part of this line; but its general correctness has been proved, since its location, by finding that its continuation southward passes directly across the known edge of the field, at Chatsworth, in Livingston county. Along the northern part of the line, numerous borings have been made and a few shafts sunk. The only ones now furnishing coal are Hook's and Gamble's shafts, in section 8, and Conklin's shaft, in section 19, of township 31 north, range 9 east. Hook's shaft is sixty-three feet deep to the coal, with the following section:

	Feet.	In.
1. Soil and sandy loam	4	
2. Brownish clay, with cobble-stones	4	
3. Blue boulder clay	30	
4. Bluish clay shales	25	
5. Coal	2	10
6. Fire-clay	2	
7. Sandstone	6	

At Gamble's shaft, which is a little shallower, Nos. 2 and 3 of the foregoing sections are wanting; and the shales of No. 4 con-

tinue up to the sandy sub-soil. All of these mines find the coal of pretty uniform thickness, and furnish a good clean coal, well fitted for domestic use and for steam fuel. Their product is all delivered to wagons, for the local supply of the country to the east and southeast of the mines; and the extent of the coal field in this county is so small as to render it doubtful whether a railroad will ever be so built as to give them outlet to a larger market.

The seam is the continuation of that so largely mined about Morris, in Grundy county, and in the lower corner of Will county, namely, "No. 2," of the Illinois valley section. As in the adjoining part of the field, the limit of the seam is quite irregular, the numerous borings having shown that, at some points, currents have washed away the coal, so as to leave deep depressions in its outline, and at others, projecting and even isolated patches of the seam are found outside of the general boundary. In the latter case, the seam is sometimes found of full thickness, but without a roof, while in others, only a streak of coaly matter is left.

The extent of the beds of the Coal Measures below this seam is unknown. They here rest directly upon the greenish, sandy shales of the Cincinnati group, which, to the uneducated eye, are not readily distinguishable from the bluish drab, sometimes sandy, shales of the Coal Measures.

Niagara Limestone.—No lower Carboniferous or Devonian beds are known to exist in Kankakee county. It is, of course, possible that such may remain in place, under the high country of the southeastern corner of the county, but their existence is in no way indicated, and is altogether improbable.

The highest Silurian beds exposed are impure earthy limestones which outcrop along the Iroquois, from Sugar Island, at the county line, nearly to its junction with the Kankakee. The outcrop covers so much space that it would be difficult to make any exact measurement of the thickness of these irregularly bedded strata. I estimated them at from fifty to sixty feet. They have mostly a moderate dip to the southward. Some of the layers have been quarried, in the small way, for local use; and many of them appear well fitted for making hydraulic lime.

These beds apparently correspond in position with the LeClaire limestones, forming the top of the Niagara group; there is no marked separation from the lower beds. A few indistinct plant markings were the only fossils found.

Apparently belonging between these beds and those which outcrop near the mouth of the Iroquois, though on that stream no equiva-

lent strata were seen, are the layers which are quarried at Momence. Here we find from fifteen to eighteen feet of light gray and drab, impure, argillaceous limestone, the upper half of which contains great numbers of concretions of chert and silicified corals; but the lower half makes a fine building and monumental stone, and is largely quarried in the bed of the river.

There are also exposed, just above town, a few feet of light buff, very vesicular, magnesian limestone full of casts of fossils, which is burned for lime. This apparently belongs beneath the quarry-stone. Among the fossils of this bed were observed *Pentamerus knightii*, *Bumastes*, *Platyostoma*, *Favosites*, *Cystiphyllum*, and fragments of undetermined crinoids.

Along the river, between Momence and Aroma, a small amount of thin-bedded limestone crops out, but presents no opportunity for measurement. Both at Aroma and for a short distance up the Iroquois we find from ten to twenty feet of thin, roughly-bedded, pretty compact, light drab and buff limestone, occasionally cherty and full of the striated marks of pressure and slipping which are called *stylolites*. These are locally used for building, though not at all a handsome material. No fossils were obtained here, though they probably occur.

In descending the river, the next outcrop seen is at Kankakee City, where, beneath the bridge, twelve or fifteen feet of thin-bedded light buff vesicular limestones are exposed, which are sometimes quarried for the linings of wells, for foundations, or for road material. At the foot of Court street large flags are quarried, with small quantities of thicker stone, from an outcrop of thin-bedded compact to vesicular bluish-gray limestones, with partings of greenish clay. The surfaces of these layers often show crinoidal fragments, and occasionally present small crystals or fragments of pyrite. The same beds continue up Soldier creek, and are largely quarried above the Wilmington road, where the greater amount of covering has prevented the disintegration of the clay-layers, so that the beds appear to be more solid. At this point a slight southerly dip is apparent. The broad floor of the quarry is strongly marked by a double system of joints, the best developed of which bears by compass due northwest and southeast; the other set is not regular. The same beds present a nearly continuous outcrop down the river through section 24, township 31 north, range 11 east, and are underlaid in section 23 by a few feet of cellular limestone containing casts of crinoids and other fossils, which is locally used for fences. In section 16 we pass down to very compact, though rather thin-

bedded limestone, every way fitted for building purposes, for which it is occasionally used. These beds apparently correspond with those quarried at Joliet, in Will county. The same beds are known to exist, at slight depths below the surface, over much of the southern part of this township, and have been opened for local use at two or three points. They are also worked in a small quarry on the west side of section 7, township 30 north, range 11 east (the fractional township), where from eight to ten feet of valuable stone have been opened in the prairie. A fine specimen of *Spirifer crispus* was the only fossil seen here.

Apparently near this level, though possibly a little above it at Manteno, a small quarry has been opened in an outcrop of thinly and irregularly-bedded limestone, which is said to be easily broken up by the frost. It contains many cavities lined with calcite, and a few *Orthocerata* are occasionally met with.

In descending the river below the quarries, in section 16, we find the beds becoming thinner and more vesicular, and finally passing gradually into more impure and strongly ferruginous layers, and decomposing readily. It is this feature which has made the valley broader and the slopes of the banks more gentle in this locality.

Cincinnati Group.—Just at the county line we pass below the Niagara group, and find about ten feet of the sandy calcareous shales of the Cincinnati group exposed above low-water mark. This is the only *outcrop* of rocks of this group within the county, but the two ranges of townships west of this point are almost entirely underlaid by them at slight depths. The prairie surface gives no opportunity of determining the exact outlines of the group; but it is evident that the Coal Measures occupy but a narrow strip of the western side of range 9, and the Niagara limestone a probably still narrower one on the east side of range 10.

A boring in Otto township, five and a half miles south of Kankakee City, and eighty rods west of the railroad, started above the top of the highest beds seen on the Iroquois; and the following section of it was reported to me by Mr. H. A. Williamson, of Kankakee City, who superintended the boring, after it had reached the depth of two hundred and eighty-seven feet:

		Feet.
1.	Gravel and clay	47
2.	Clouded solid stone—not limestone	388
3.	Shale, with limestone bands and flints	75
4.	Impure limestone, slacked but little	40
5.	Nearly black, slightly gritty shales	15

	Feet.
6. Shale, with limestone bands and "flints"	83
7. Pyrite	1½
8. White shaly limestone	1½
Total	651

The three hundred and eighty-eight feet of "clouded solid stone," undoubtedly includes all the limestones, pure and impure, of the Niagara group. The impression that it was "not limestone" arose from the fact that certain specimens, when burned, did not slack. No. 3, with its "flints," may possibly belong to the Niagara; but I am more inclined to account it the top of the Cincinnati group, and to suppose the "flints" of both it and No. 6 are merely thin layers of compact clinking limestone, sometimes pyritous, such as are frequently called flint by borers and quarrymen, although they contain no noticeable amount of silica. Nos. 7 and 8 apparently represent the top of the Trenton limestone. If that bed has here a thickness of two hundred feet, which is usual in this part of the State, the top of the water-bearing St. Peters sandstone would be reached at eight hundred and fifty-one feet, about one hundred feet nearer the surface than it would be if the dip observed in Grundy and Will counties was continued to this place.

Economical Geology.

The local supply of all especially valuable minerals is small, and the county must rely for wealth chiefly upon its agricultural and manufacturing capacities. Aside from the sandy ridges of its river bottoms, its soil is fertile and already produces large crops. But much of the surface is yet uncultivated, and, as elsewhere in fertile countries, the abundance of rich land leads to wasteful farming, which before many years must inevitably lead to the production of "old fields," the characteristic result of such farming in the older States. The remedy, of course, lies in thorough manuring, which is and always will be neglected by those who are ambitious to have the *largest* farms, without regard to the rate of production. The abundant marshes or sloughs, often underlaid by deposits of shell marl, furnish the best material for rendering the sand ridges fertile.

The water-power of the Kankakee is partially utilized by four or five dams and mills; though not a tithe of it is thus employed, though it might be made the source of immense wealth.

Coal exists in sufficient quantities for domestic use, though even for this it must be hauled many miles; but it can hardly be profitably used in extensive operations until a railroad shall bring it directly from

a larger coal-field near at hand. If the east and west road through the county, so long talked of, should be built, an abundant supply of coal would be brought from Grundy and LaSalle counties; otherwise the reliance must be upon Vermilion county and the Indiana field, whence coal will soon be delivered in the eastern part of the county by the new Chicago, Danville and Terre Haute Railroad. The Danville coal is now brought to Kankakee City *via* the Great Western and Illinois Central roads; but the route is so circuitous that freights make a very heavy addition to the cost. Possibly the coal recently discovered in Iroquois county may prove sufficiently abundant to be the best source of supply for Kankakee county.

Iron.—Bog ore is known to exist in small quantities in some of the sloughs near the State line. If larger beds can be found within easy reach of the new railroad, there seems to be no reason why Momence should not speedily have an iron furnace, supplied with bog ore from its own neighborhood, with richer ores from Lake Superior *via* Chicago, with "block" coal direct from the Wabash, and a blast driven by the water-power of the Kankakee. If this be undertaken it would be well to examine more thoroughly the beds of

Peat, which are known to exist near that place, though now supposed to be of small extent.

Building Stone is quarried at many points in the county. The best rock seen is in the southwest corner of Limestone township, in section 16 of that township, and in the river bed at Momence. The quarries in section 16, of limestone, should be more largely developed, and made to supply stone to all the neighboring country. If the Kankakee were rendered navigable this might be made a very profitable business, and would pay well even as it is. The rock quarried at Kankakee City is very objectionable, on account of the abundance of shaly partings, which must ultimately cause the destruction of buildings now erected at so great expense. It would be much wiser for builders of any large structure, especially of those of so extensive and elegant a character as the Methodist Church in that city, to pay enough more to cover the expense of hauling good stone five miles, than to use at less expense a material which will insure the ultimate destruction of the buildings by weathering at no very distant day.

Water.—Artesian wells can probably be obtained anywhere in the county, at a depth nowhere exceeding twelve hundred feet; and it is probable that a permanent supply could be had at nine hundred feet, in the western part of the county. The water from the St. Peters sandstone has, in some cases, been found quite saline; but

in such cases a purer water can generally be reached by boring into the underlying Calciferous sandstone, and tubing out the upper flow. No artesian waters have yet been obtained in this county, the only deep boring, the "oil well," south of Kankakee City, having stopped at the top of the Trenton limestone.

The Drift beds which supply the numerous flowing wells of the south part of Iroquois county, apparently do not exist north of the east and west portions of the Iroquois river valley.

Iroquois county is bounded on the north by Kankakee county, on the west by Livingston and Ford, on the south by Ford and Vermilion counties, and on the east by Indiana. It contains eleven hundred and fifty-six square miles, being thirty-four miles square.

Of this area, far the larger part is gently rolling prairie. The northeastern quarter is separated from the rest of the county by the Iroquois river, which, entering the county from Indiana, a little north of the center of its east line, flows in a general west course to near the middle of the county, and thence nearly due north into Kankakee county. This stream is quite sluggish, and navigable for flatboats from the northern county line up to Middleport; above this point it is smaller and more broken. Its principal branches are Sugar creek, from the southeastern part of the county, and Spring creek, from the southwestern. All these streams have considerable bottoms; but those of the main Iroquois are especially interesting, on account of their connection with the subject of the old Lake Kankakee. All along this valley, and for considerable distances from the present river bottoms, we find the extensive accumulations of sand which mark the bottom and shores of the old river valley. These beds have not been traced along the upper part of the river, so as to ascertain whether or not they are continuous with those of the upper Kankakee, as has been suspected; but the lower portion of the valley was certainly filled by a broad arm of the expanded channel through which the waters of Lake Kankakee passed to the narrower outlet below. In my report upon Kankakee county I have expressed the opinion that Lake Erie may possibly have, at one time, poured out its waters in this direction; but further consideration of the summit-levels of the Wabash has shown that that stream would have given exit to the waters of Lake Erie at all times when its elevation would have approached that of Lake Kankakee.

The sands of these old river, or estuary bottoms, are mostly quite pure silex, and blown about by the winds. Judging from the material, it would seem probable that at least the larger part of them

originated from the disintegration of the sandstones of the base of the Coal Measures, which formerly covered the larger part, if not the whole, of this county, together with an extensive region on the upper Iroquois. They therefore have little fertility, except what is due to the small quantity of river-silt deposited with them, and the debris of the small amount of vegetation which has thus far grown upon them. They are in some places entirely barren; in others, they are covered by a thin growth of oaks and hickories. The present river bottoms are of course well covered with a great variety of timber, being very fertile.

The remainder of the county is rich, rolling prairie, covered with the characteristic deep, black, mucky soil which produces such heavy growths of all sorts of vegetables. This is based upon generally thin clay beds of the "Loess," and this upon the sands, gravels, and heavy boulder-clay of the Drift period, which latter bed is, in at least one case, one hundred and sixty feet thick. In a well sunk at Sheldon, the gravel above the boulder-clay was found compacted into a coarse sandstone. At a shaft and boring made in 1865, by Mr. John Faulds, of Vermilion county, between Onargo and Gilman, the following section of these surface deposits was obtained:

	Feet.
Blue and red clay	98
Sand and soft sediment	140
Hard-pan	10
Hard stony clay	20
Total	268

At this depth limestone was encountered, and the boring stopped. This may have been only a boulder, but was more probably a solid bed of the Niagara group. A boring made in 1866, between Onargo and Spring creek, is said to have reached a depth of four hundred feet without encountering any solid rock. These and other borings in this region have indicated the existence of an old channel running through the county, which is now entirely filled with the Drift deposits. Examinations in adjoining counties have shown that this is the continuation of the valley now filled by Lake Michigan. Its course is southward from the southern extremity of the lake, trending a little westwardly (though still passing to the eastward of Momence, in Kankakee county), until near the northern line of Iroquois, where it bends more strongly to the westward, and passes on to the southwest corner of the county, with its eastern border near the Spring creek valley east of Onargo, and its western at Chatsworth, in Livingston county. Passing on to the southward and westward, Urbana was within its limits, though probably near its eastern bor-

der; and Bloomington appears to have been near its center. Further westward, its location has not been determined. This valley was doubtless first excavated by the glacier which dug out the basin of Lake Michigan; and, as this gradually melted and retired, the material of the "terminal moraine" partially filled the channel, while the river formed from the melting ice still occupied a part of it. The partially filled bottom, as the glacier retired to Lake Michigan and beyond, became overgrown with vegetation, the remnants of which we find both in distinct beds, such as have been encountered in boring and shafting at Chatsworth, Urbana and Bloomington, and in the sand and gravel beds which afterward accumulated and filled the valley.

Rock Formations.

No outcrop of rock is known within the county, and we are obliged to rely wholly upon bores and shafts for our knowledge of the underlying beds. The southeastern part of the county is probably underlaid by Coal Measure rocks; but the only point at which this is *known* to be the case, is between Gilman and Watseka, where coal is said to have been found recently at a depth of one hundred and five feet. Reported thickness of seam, eight feet. No details known at the present writing.

Limestone was reported as existing on the bank of the Iroquois, in section 14, township 27 north, range 13 west, but no outcrop was found; and all evidence favors the supposition that loose fragments found there were remnants of loads of rocks formerly brought in flat-boats from Sugar Island, just below the county line in Kankakee county. These rocks are the uppermost beds of the Silurian, and may be referred to either the Onondaga Salt group, or the top of the Niagara group.

A boring at Onargo encountered its first rock at about three hundred feet in a bed of calcareous shale, which should probably be referred to the upper part of the Cincinnati group, the overlying Niagara and Coal Measure rocks having been removed from their original position here during the excavation of the glacier valley.

It is not improbable that some thin continuations of the Devonian and lower Carboniferous rocks of Indiana might be found in place, between the Niagara limestone and the Coal Measures, in the eastern part of the county; but it is not probable that they reach to the western portion of it.

Economical Geology.

It is probable that enough coal will be found in the southern part of the county to become largely an article of export, as well as to supply the local demand. From the position in the Measures which the seams here to be found probably occupy, it is not improbable that they may furnish the free-burning "block" coal so much sought for, for furnace use. But of this, nothing is known yet.

Limestone for buildings, though not of the most durable variety, can be obtained in any quantity along the lower course of the Iroquois, in Kankakee county, and can be brought in flat-boats to the center of the county. Some of the same beds will yield a good article of hydraulic lime. A strong building lime can be obtained at Momence, and brought into the county very cheaply by the new Chicago and Danville railroad.

The river bottoms are, of course, well supplied with water, and the prairie portions of the southern half the county, besides getting moderate supplies by the shallow wells in the sub-soil, also obtain unlimited quantities of flowing water by forcing "drive wells," or sinking borings from thirty to sixty feet into the sand or gravel beds which occur in the top of the boulder clay. The occurrence of artesian water at so slight a depth, and especially in unconsolidated deposits, is very uncommon, though not unknown elsewhere. The cause of the phenomenon is a little uncertain. I was at first inclined to suppose that the water supply came from the higher land of Central Indiana, north of the Wabash; but have concluded that that position is untenable. The only explanation which has proved entirely satisfactory to me, is that which refers to the source of the water to the St. Peters sandstone, which supplies so many artesian wells in LaSalle, Grundy, Will and Cook counties. Following the line of the anticlinal axis, which runs south 33° east from LaSalle, we find that it passes very near Urbana, at which place deep borings in the materials which fill the old valley, before described, have found at the bottom a pure white sand, closely resembling that into which the St. Peters disintegrates at its outcrop. This sand, and others in contact with it, are so abundantly filled with water in all this region, as to have defied all efforts to sink shafts through it; and it is natural to refer the water to the artesian supply of the St. Peters. If the boulder-clay were continuous over the whole region, it would not be likely to allow this water to ascend and escape, except from the edges of the stratum; but as the Lake Michigan

glacier must have continued to occupy this valley after the disappearance of the universal glacier which covered the whole country, and deposited the boulder-clay over the general surface, its later deposits, though of the same material, were not continuous with the earlier ones; and it is through the beds formed along the slopes of the valley that the water probably finds means to escape to a higher level. It is only the topmost layers of the boulder-clay and those of the overlying clays of the Loess which prevent its escape everywhere to the surface.

Many persons have been inclined to suppose this to be "mineral water," or "poisonous," because where the surplus overflow has been allowed to run through orchards, it has killed the trees. But this was only in consequence of their being *suffocated* by the water preventing the access of air to their roots. Care should be taken, in sinking these wells, to select points where the surplus water can escape directly to the channels of natural drainage.

The area within which these wells have been successfully sunk is about fifteen miles from north to south, and about thirty-seven from east to west, including a small part of Ford county, as indicated upon the map. At many points outside of this area, the water comes within a few feet of the surface, so as to be pumped out with the utmost ease.

For information concerning this county, I am especially indebted to Edward Rumley, Esq., of Onargo, and H. F. Wing, Esq., of Kankakee City.

CHAPTER XXVI.

VERMILION COUNTY.

This county lies on the eastern border of the State, about midway of its length, and is bounded on the north by Iroquois county, on the west by Ford and Champaign counties, on the south by Edgar county, and on the east by Warren and Vermilion counties, of Indiana. It is forty-two miles long and about twenty-one miles wide, giving an area of about eight hundred and eighty square miles.

The surface of the county presents considerable variety. The northern and southern portions are high rolling prairies, the eastern arms of Grand Prairie, more or less broken by the sloughs and small streams which gather from their surface the main supply of the water which fills the Big and Little Vermilion rivers. Through its center, Salt Fork, which drains a considerable portion of Champaign county, runs in a general easterly direction, until, by its union with Middle and North Forks, it becomes the Big Vermilion, and, near Danville, turns southeastwardly to join the Wabash below Eugene, Indiana. In its entire length within this county, it runs through a belt of timber varying from two to four miles in width. Through the western third of the county, the Little Vermilion is little more than a prairie drain, but becomes of more importance in the lower part of its course, where it is lined with from one to three miles of timber. Both Middle and North Forks have considerable timber along their banks for ten or twelve miles above their junctions with Salt Fork, but only scattering groves farther up. Below the points where they enter the timber, all of these streams have high bluffy banks, with noticeably wider bottoms where they have cut through the softer beds of rock, and narrower ones where they have encountered the harder sandstone. The prairies have a dense, black mucky soil of variable depth, underlaid in most cases by a tough, brown

clay subsoil. Along the streams the soil, and in many places the sub-soil, has been removed by drainage, and the underlying more porous clays and gravels have allowed of a heavy growth of timber. Upon the higher grounds, this consists principally of white and black oak and hickories, with only a small proportion, though a considerable variety, of other species. The bottoms support a dense growth of oaks, white and black walnut, mulberry, elm, hackberry, etc., with not unfrequent groves of sugar-maple.

Alluvium.—The alluvial deposits of the bottoms, composed of the broken-up materials of all the older beds which have been worn away in the excavation of the valleys, together with the portions which are continually brought down by the small tributaries, cover considerable surfaces, but have nowhere accumulated to any great depth.

Loess.—The marly and sandy clays of the Loess, a lake deposit made before the formation of the present soil, are not very thickly developed in this county, though they include the brown clay subsoil which underlies almost the entire surface. The only shell-bearing clay observed, though it is doubtless common in the prairie sloughs, is about two miles southeast of Fairmount. The black soil is here from one to two feet thick, and is underlaid by a light-brown, tenaceous clay, filled with the calcareous shells of *Lymnea*, *Physa*, *Planorbis*, *Sphærium*, etc. In some portions these have decomposed, and we have white, marly lumps and streaks which are characteristic of beds of this formation. At this locality the partially decayed skeleton of a Mastodon was found, in September, 1868. The bones were lying partly upon, partly embedded in, this marly clay, the tip of one of the tusks being within thirteen inches of the surface. The slough had been mostly drained of late years, the air had permeated the bed and pretty thoroughly decayed the bones, which were doubtless in good preservation as long as they were constantly covered with water. The parts were promiscuously mingled, showing that the animal had not been left to decay undisturbed. Marks of gnawing upon a few of the bones give reason to suppose that the water in which the animal lay was so shallow as to give access to wolves or other carniverous animals. The fragments are now in the possession of the Chicago Academy of Science.

I am informed that, in the early settlement of the county, the bones of these animals were quite common in the sloughs of this region, and even at the present day the discovery of isolated fragments is no rare occurrence. It seems probable that a little careful searching in such localities would secure some still perfect skeletons.

It is evident that these enormous animals roamed in considerable numbers over the prairies at no very remote period.

These beds of Loess are everywhere underlaid by the

Boulder Drift.—The deposits of this age form extensive beds in the northern part of this county. They have been penetrated to the depth of one hundred and fifty feet, near the north line of the county, where they compose the dividing ridge between the waters of the Big Vermilion and those of the Iroquous. Along both sides of the Middle and North Forks of the Big Vermilion they form extensive bluffs, in some cases one hundred feet high. Two members are here represented; the upper consisting principally of heavy beds of sand and coarse gravel, with occasional thin layers of clay, which, where near the surface, have been discolored by the oxidation of the small portion of iron which they contain, and appear as yellowish and reddish-brown beds, but, at greater depths, still retain the original blue tint which is the prevailing color of the lower members.

In connection with these upper beds of the Drift, and also with the Loess, we find, scattered over the surface of the county, many large masses of limestone and occasionally sandstone. In several cases, these are so large and so deeply embedded as to have induced the belief that they were the outcropping edges of solid beds of rock. Some of these masses are composed of a beautiful, light, fawn colored limestone, of a homogeneous, fine-grained texture, and destitute of fossils, so far as noticed. Kilns of lime have been burned, from rock of this character, one or two miles north of Rossville, and also about one mile south of Mann's chapel, in section 36, township 22 north, range 12 west. One mile south of this latter locality, and also at about the same distance to the northwest, there were observed several large masses of a dark, semi-crystalline, bituminous limestone, with a few fossils. The rock is supposed to be Silurian. Smaller fragments of the light-colored rock are not unfrequent to the southward, even as far as Terre Haute. The general appearance of the stone would indicate that it belongs to the Coal Measures, but no outcrop of an exactly similar rock is known, so that its origin is uncertain. In the western part of this county, and in the adjoining part of Champaign, there are numerous scattered masses of a light-drab, semi-crystalline or fragmentary to massive, sometimes shaly, limestone, highly fossiliferous, which belong to the bed marked No. 1, in the general section of the rocks of the county, and indicate its former extension towards the north and west. Many of the other rocks of the county are also locally distributed in con-

nection with these upper beds of the Drift, as at Danville, where, in the banks of gravel stripped from over the coal, we find very numerous thin slabs of a compact, fragmentary to semi-crystalline limestone, containing numerous fragments of fish teeth—No. 21 of the general section—which, at Rock Ford of Salt Fork, lies ninety-five feet above the Danville coal. These beds, also, not unfrequently contain fragments of coal and shale, which have led many persons to suppose that coal was necessarily close at hand. But they also contain lumps of native copper transported from Lake Superior, and bits of lead ore from the Galena region; and it is by no means certain that the coal of the same beds has all been taken up from the immediate neighborhood where it is found. These masses of coal and shale are abundant in these beds, as far as Lake Michigan at least, and it is still an open question whether they have been swept down from the Michigan coal fields, or are the remnants of some broken up beds which may formerly have connected that with the Illinois field.

Both these beds and the lower member of the Drift formation give rise to numerous springs, some of which have taken up so much lime from the limestone pebbles which fill the gravel, that, upon coming to the surface, they make abundant deposits of tufa, as along the bank of the Big Vermilion, at Danville, and especially at the "Moss Bank" on North Fork, about one mile northwest of that city. Some of the deposits are light and porous, and take beautiful impressions of the mosses, twigs, and leaves which become embedded in them. Recent snail-shells, thus fossilized, are not rare.

In other cases, the deposition has gone on more slowly and without the introduction of extraneous matter, and we find as the result some very solid masses with a radiating semi-crystalline structure, which approximates more nearly the ordinary stalagmitic formations.

The lower member of the Drift—the "boulder-clay"—is a tough, light-blue clay, filled with gravel of various degrees of fineness, with some larger boulders. In this county, it is from fifty to eighty feet in thickness, and forms some considerable bluffs, as at Mill's mill, on Middle Fork, where it is capped with the gravel and sand of the upper member. It also forms the mound of Kyger's mill, near the mouth of Grape creek. Here, the river ran for centuries to the west of the mound, and excavated a broad valley, which is now deserted and partially filled up, and the stream passes to the eastward, leaving a small island of the boulder-clay, which presents an almost perpendicular face on the east side, where it is now under-

mined by the current. Curiously enough, a spring of cold water flows out at the top of this mound.

Coal Measures.—The rock formations of this county all belong to the Coal Measures. The following is a general statement of the section, from the highest beds seen in the county to the junction of the Big Vermilion, with the Wabash river below Eugene, with the addition of the section from the lowest beds there seen to the bottom of the Lodi salt well, as carefully determined and reported by John Collett, Esq., of Eugene. It was found necessary to make these connections with the Indiana field, both in order to judge of the beds underlying Vermilion county, and also to connect the section in Vermilion with that in Edgar county:

		Feet.
1.	Light-drab limestone	12 to 18
	Level of coal No. 12	?
	Covered	?
2.	Shaly sandstone, with some solid beds	25 to 50
3.	Olive, dark-red and light-blue shales, lower part sandy and micaceous, with bands of argillaceous limestone	5 to 20
4.	Black shale	0 to 3
5.	Coal, No. 11?	0 to 1½
6.	Fire-clay	0 to 2½
7.	Sandy shales	0 to 10
8.	Light-drab clay shales, with ironstone nodules	0 to 15
9.	Argillaceous limestone, with shaly partings	½ to 4
10.	Black shale, some slaty	½ to 3
11.	Coal, No. 10?	0 to 2
12.	Drab fire-clay	3 to 6
13.	Light-drab sandy shale, with iron veins	6 to 8
14.	Black shale, with ironstones—*Cardiomorpha*, etc	½ to 2
	Level of coal No. 9	?
15.	Variously colored shales and clays, with bands of concretionary argillaceous limestone	8 to 40
16.	Sandy shales and shaly sandstones	15 to 20
17.	Soft drab clay shale	0 to 1
18.	Shaly sandstone, with *Caulerpites*	10
19.	Argillaceous and ferruginous limestone—few fossils	½ to 2
20.	Dark drab shales, with ironstones	20 to 25
21.	Limestone, semi-crystalline to concretionary	4 to 8
	Level of coal No. 8.	
22.	Coarsely concretionary clay shale	8 to 10
23.	Carbonaceous sandy shale and shaly sandstone	15 to 40
24.	Fine-grained sandy shale, with ironstones	30 to 40
25.	Dark and light-drab clay shale, bottom fossiliferous	10 to 30
26.	Soft black shale, with pyritous fossils and nodules	0 to 5
27.	Coal, No. 7	3½ to 7¼
28.	Fire-clay	0 to 3¼
29.	Coal (parting of No. 7)	0 to 2
30.	Fire-clay	6 to 15
31.	Sandy shales and shaly clay	9 to 12
32.	Compact siliceous limestone	1 to 1¼
33.	Dark shaly clay	5 to 10
34.	Coal, No. 6	3½ to .7

		Feet.
35.	Fire-clay, with concretionary limestone	5 to 20
36.	Sandy shales with ironstones—some quarry-stone near top	50 to 80
37.	Clay shales, with few ironstones	20 to 40
38.	Black concretionary ferruginous limestone	½ to 3
39.	Black clay shale, some slaty	3 to 6
	Level of coal No. 5.	
40.	Soft light-drab shale	½ to 1
41.	Shales and sandstones	15 to 30
42.	Dark-drab clay shales	5 to 20
43.	Argillaceous limestones, changing to calcareous ironstone	1 to 3
44.	Sandy shales, with some heavy beds of sandstone, with some ironstones and "cone-in-cone"	35 to 40
45.	Black slaty shale, with ironstones	2 to 3
46.	Coal, with bands of shale, No. 4	4 to 14
47.	Shales, with limestone bands	10 to 20
48.	Black slaty shale, with some cannel	2 to 3
49.	Coal, No. 3	1 to 1⅔
50.	Fire-clay and stigmarial sandstone	4 to 6
51.	Shales, with limestone band	10 to 15
	Top of Lodi salt well	
52.	Argillaceous limestones and calcareous shale	4 to 8
53.	Coal, No. 2	1 to 5

		Ft.	In.
54.	Fire-clay, and shales with iron nodules	1	6
55.	Hard white sandstone	20	
56.	Argillaceous sandstone, with thin streaks of coal	10	
57.	Argillaceous sandstone, white	8	
58.	Laminated sandstone, with ironstones at bottom	16	9
59.	Sandstone and shale	12	7
60.	Sandy shale, with streaks of coal and slate	17	1
61.	Buff and white fine-grained micaceous sandstone, bottom coarser	20	
62.	Black and drab clay shale, some sandy layers at bottom	8	11
63.	Coal, "Conglomerate seam"	1	6
64.	Black shale	12	
65.	Soft clay shale, or fire-clay	19	
66.	Hard sandstone	32	
67.	Clay shale, few bands of sandstone	24	1
68.	Clay shale, frequent bands of sandstone	30	7
69.	Very hard sandstone	2	3
70.	Sandy shale	60	7
71.	Fine sandstone	46	5
72.	Shale, some portions sandy	92	11
73.	Hard fine sandstone	2	9
74.	Shale, with bands of coarse sandstone	95	1
75.	Hard sandstone	6	10
76.	"Flint" (probably compact limestone bands, possibly a geode bed)	8	2
77.	Shale, some sandy	44	11
78.	Compact, coarse sharp sandstone, with pyrites	10	3
79.	Fine sandstone, some shaly layers	54	7
80.	Soft clay shale	8	8
81.	Shale, with some fine grit	65	5
82.	"Flint"	1	
83.	Porous sandstone	7	3
84.	Clay shale	5	3
85.	Compact white sandstone	40	5
86.	Sandstone, with flinty layers	34	1
87.	Flint	1	6

		Feet.	In.
88.	Soft sandstone, top ochreous	9	4
89.	Soft clay shale	39	5
90.	Shale, with compact sandstone at bottom	26	2
91.	Bituminous shale	102	1
92.	Hard, coarse, calcareous sandstone, fossiliferous	23	1
93.	White fossiliferous limestone	9	10
94.	Flints	2	2
95.	Magnesian limestone	7	10
96.	Flint	10	10
97.	Compact limestone, with flint	22	
98.	Magnesian limestone, with flint	23	10
99.	Soft fine sandstone	5	
100.	Compact fine sandstone	10	
101.	Gray limestone	6	
102.	Hard drab to the semi-crystalline limestone, with drusy cavities	28	10

No. 1 of the foregoing section, as already stated, is a light-drab or fawn-colored fine-grained sub-crystalline to massive limestone, in some parts quite pure, in others somewhat shaly and ferruginous. It is generally quite fossiliferous, containing *Productus*, 2 or 3 species, *Spirifer lineatus*, *S. cameratus*, *Athyris subtilita*, *Terebratula bovidens*, etc. The only known outcrops in this county are near Big Spring, south of Fairmount, on section 16, township 18 north, range 13 west, and for two or three miles south and west of this point. The bed is here said to be from fifteen to eighteen feet thick, though the bottom has never been certainly reached, and only from five to ten feet are now exposed. Some lime has been burned here, and considerable portions of the bed seem well fitted for that use. It is too irregular, and breaks up too readily with the frost, to be of any value as a building stone. The same bed occurs at several points in Edgar county, where portions of it afford very solid stone, fitted for any rough work, such as foundations and culverts. The supposed outcrop of this rock at Osborn's mill, on Salt fork, a half-mile east of the county line, is only one of the large drifted masses before mentioned. From below this limestone flow very strong springs; therefore, although there is no outcrop of the rock on the south side of the water-shed toward the Little Vermilion, where we should naturally expect to find it, I am inclined to consider the strong springs on the land of John M. Sidell, near the west line of township 17 north, range 13 west, on the north side of the Little Vermilion, as pretty good signs of its presence at that point. Still, some other circumstances may have given exit at that point to the water, which, in both cases, doubtless comes from the great water-bearing quicksand of Champaign county.

Below this limestone there is in the section a space of undetermined thickness and character, since no outcrop has been found

which will give a connected view of this and the sandstone beds numbered "2," and no borings have been made in this neighborhood to decide the matter. It is entirely possible that the limestone belongs below this sandstone, and is simply missing from its place in the section along Salt Fork, in consequence of having been removed by the heavy erosion which the beds in that region evidently suffered before the deposition of the sandstone No. 2. There is, however, at present no sufficient reason for believing this.

No. 2 of the section is first met with in following down Jordan creek, about two miles north of Fairmont, in the south half of section 27, township 19 north, range 13 west. It is here a very shaly rock, and of no practical value; but in sections 20 and 21 of the same township, above and below the Conkeytown bridge over Salt Fork, it furnishes some more compact beds, which have been quarried for foundations and bridge abutments. One of these layers, near the bottom of this bed, from one to two feet thick, is a very solid stone, and would pay for quarrying if the quantity were greater. From its outcrop along the base of the river bluffs considerable quantities have been gathered for use at Fairmont. Less compact layers from the upper part of this bed are quarried, to some extent, at Davis' quarry, in the south part of section 31 of this township, and are said to become hard and durable under the action of the weather, on account of the contained oxide of iron. Other openings in this neighborhood are now abandoned.

These are the highest beds exposed upon Salt Fork. In going but short distances up and down the stream we come upon the underlying thin coal seam, with its accompanying black shales and argillaceous limestones, so that this is evidently a point of the north and south axis of the synclinal between the eastern border of the coal-field and the axis of elevation which has been noted as running about south 33° east from the neighborhood of LaSalle. This latter axis must evidently pass through the adjoining county of Champaign, though the upper strata were there so extensively removed before the Drift period that no outcrops now exist to show what the actual dip is.

Through the eastern part of Vermilion county the dip is mainly to the southwest, at a small angle, though local dips are very various. In ascending Salt Fork these characters are constant until we pass the west line of township 19 north, range 12 west, where the dip becomes much more rapid for a few miles, and until it is reversed at the synclinal, above which the eastward dip is very gentle.

Nos. 4 to 12 of the section are exceedingly variable in their characters and succession, so that it is very difficult to give a general section which shall fairly represent their different aspects. Their most noticeable components are the bands of argillaceous limestone near the top of the series, which are sometimes compact and sometimes marly, but always contain great numbers of fossils, especially *Hemipronites crassus* and *Productus longispinus*, together with *P. costatus*, *P. Rogersii*, *P. scabriculus*, *Athyris subtilita*, *Spirifer cameratus*, *S. plano-convexus*, *Spiriferina Kentuckensis*, *Retzia Mormoni*, *Cyathoxonia prolifera*, plates of *Zeacrinus*, and various Bryozoans. The black shales which appear sometimes above, sometimes below, and sometimes between these limestone bands, are sometimes soft and sometimes slaty; under all which variations we find them containing a few specimens of *Discina nitida*, *Lingula*, and rhombic fish-scales.

Above the synclinal axis the coal accompanying these beds is pretty constant, with a thickness of six to twenty inches; further east it is very thin, and in some cases disappears. Near the west line of section 35, township 19 north, range 14 west, I also found a point where the whole of these beds had been removed by erosion, and the shaly sandstone of No. 2 had been deposited directly upon No 13. These beds also occur just above the mouth of stony creek, with six inches of coal. In ascending this creek no rock was found above No. 2, which forms the banks just above the crossing of the State road, in section 22.

In descending Salt Fork the black, slaty shale of No. 14 is found in the tops of the hills below Major's mill, accompanied by large concretions of black calcareous ironstone, containing *Cardiomorpha Missouriensis*, *Orthoceras*, *Nautilus*, and fish-scales.

The shales of No. 15 are generally green and red. The limestone bands accompanying them are in some places crowded with fossils, such as *Myalina*, *Nucula*, *Leda*, *Monopteria*, *Ariculopecten*, *Bellerophon*, *Macrocheilus*, *Hemipronites crassus*, *Athyris subtilita*, *Productus scabriculus*, etc. The best locality is about eighty rods below Major's mill, on the north bank of the Oxbow bend.

No. 18 is a shaly sandstone which furnishes a good horizon for recognition, since it is characterized by a great abundance of more or less perfect fronds of the fucoid, *Caulerpites marginatus*, Lesqx. This is found to occupy nearly the same position in the section in Edgar county.

No. 19 is analogous in character with Nos. 3 and 9, and contains the same fossils, with the addition of *Myalina*, *Orthis Pecosi*, and scales and teeth of fishes.

No. 21 is generally a very compact, fragmentary to semi-crystalline limestone, ringing under the hammer, and marked by the presence of numerous bony scales and teeth of fishes. At Rock Ford, below Major's mill, in the northwest quarter of section 25, township 19 north, range 13 west, this bed presents a very curious structure, having been apparently coarsely broken up by some violent action, and afterward reconsolidated by the deposition of a cement of a calcareo-ferruginous material, mingled with some sand. I have been unable to conceive of any circumstances which could have produced just such a bed of rock. It has been named to me as the result of volcanic action, but that is impossible.

Apparently belonging at the bottom of this bed, though the connection could not be clearly made out, is a bed of impure, concretionary limestone, which has occasionally been burned for lime in a ravine just east of Finley Chapel, on the southwest quarter of section 18, township 19 north, range 12 west. Only a small outcrop is here exposed, and only a few fragmentary fossils were detected; but at Garrett's (formerly Swank's) old mill, on the Little Vermilion, in the northwest quarter of section 14, township 17 north, range 12 west, we find a considerable outcrop of the whole of this bed, except the peculiar conglomerate just mentioned, which is evidently local. In the outcrop of about two hundred yards there are great variations from the very compact clinking stone, with fish remains and large valves of *Productus costatus*, to an impure, concretionary, almost granular limestone, crowded with generally quite small fossils. Among these we find *Spirifer cameratus*, *S. lineatus*, *Spiriferina Kentuckensis*, *Athyris subtilita*, *Terebratula bovidens*, *Orthis Pecosi*, *Productus longispinus*, *Waldheimia* (*Cryptacanthia*) *compacta*, *Retzia Mormoni*, *Nucula*, *Bellerophon*, *Loxonema*, *Naticopsis*, *Fusulina cylindrica*, etc.

At Rock ford, as previously stated, this bed was found to be about ninety-five feet above the Danville coal seam, No. 27 of the general section. But this distance is far from constant. My *estimate* of it on the Little Vermilion, where the broken condition of the section rendered connected measurements impossible, was not far from eighty feet; while in the shaft at Catlin, as I am informed by Mr. John Faulds, of that place, one hundred and thirty feet of sandy and argillaceous shale were passed through above the coal, without any intercalated bed of limestone.

This coal seam appears above the level of the river, near the east line of township 19 north, range 13 west; but owing to the local undulations before mentioned it dips, rises and dips again two or three times before making its final emergence a short distance below the mouth of Middle Fork. Up that stream, also, we find the coal in or not far below the bed for about two miles to near the north line of section 8, township 19 north, range 12 west, where a sudden dip carries it below the level and brings in the upper beds to the top of No. 16, which, on Makemson's branch, in the west half of section 5, contains a heavy bed of very solid ferruginous sandstone, which appears well fitted for building purposes, though no quarry has been opened. Still ascending the stream we find the rocks rising somewhat, but at the last rock exposure, on Mr. Cox's land, in section 32, township 20 north, range 12 west, the coal is probably still from forty to fifty feet below the water level. Above this point we come upon the heavy beds of Drift clay and gravel, which cover the north part of the county so deeply as to render the exact location of the underlying rocks impossible, except by boring.

The so-called "Danville" seam, No. 27 of the section, is apparently equivalent to that which is numbered "7" in the general section of the coals of the Illinois valley; but, as the numbering there adopted will not accommodate all of the seams which have a well defined level in the field now under consideration, I am compelled to adopt, *provisionally*, another set of numbers for the coals of the Wabash valley. I regret that the impossibility of determining, at the present time, the number and constancy of the seams near the base of the series east of the Wabash, has thus far prevented the adoption of a numbering which may be considered as permanent. The numbers here used, however, correspond at least so far as concerns the seams outcropping in Vermilion county, with those adopted by Prof. Cox, in his reports upon the eastern counties of the southern part of the State.

In the neighborhood of Danville, coal "No. 7," or the "Danville" seam, outcrops for many miles. It is here generally covered by from two inches to five feet of a soft black clay shale, rarely a little slaty, which commonly contains large numbers of fossil shells replaced by pyrite. This mineral is also frequently present in the form of irregular crystals and nodules of various sizes. Small nodules, apparently composed of phosphate of lime, also occur, generally inclosing fragments of fish scales; one has yielded the three-pronged tail of a *Dithyrocaris*. Among the most characteristic of the species which crowd this bed are *Aviculopecten rectilaterarius*, *Entolium avi-*

culatum, Lima retifera, Solenomya radiata, Sanguinolites carbonarius, Macrodon tenuistriatum, Pernopecten, Myalina attenuata, Leda bellastriata, Gervillia longa, Nucula parva, Astartella, Chonetes mesoloba, Discina nitida, Lingula mytiloides, Productus scabriculus, P. longispinus, Rhynchonella Uta, Dentalium Meekianum, Chiton, Euomphalus sub-rugosus, Bellerophon carbonarius, B. Montfortianus, Pleurotomaria Grayvillensis, P. carbonaria, P. Beckwithana, Macrocheilus ventricosus, M. Newberryi, Orthoceras Rushensis, Nautilus 4 *sp.*, several minute species of *Actæonina, Polyphemopsis*, etc. Where the bed is at its greatest thickness it is quite solid, and the fossils are generally readily preserved; but, in the thinner portions it is very fragile, and the superabundance of pyrites in such condition as to be readily decomposed, renders their preservation very difficult. Where the black shale is thin or entirely wanting, the overlying drab shale, which replaces it, becomes fossiliferous in turn, though elsewhere generally barren, and yields many of the same fossils, though rarely in good condition. This bed can be seen at the upper end of Donlon & Chandler's "stripping," opposite Danville, below the railroad bridge, and also along Ellis' branch, near Georgetown. The black shale is at present most accessible, in its fragile pyritous presentation, at Kelly's strippings, about one mile northwest of the court house, and at Short's strippings, across North Fork, opposite Danville, and in its more solid condition, along the inclined plane at the old Carbon Company's mines, near Tilton.

The coal is variable, both in character and thickness. Near Danville, along Salt Fork above that place, and at Lafferty's bank, on Grape creek, it varies from five feet six inches to seven feet three inches in thickness. About Georgetown, the only place in the county where it has been opened south of Lafferty's, it is said to vary from three to four feet; at the few points where it was accessible I could find no thickness over three and one-half feet. It is said to be here of very poor quality, and the mines are abandoned.

This seam is mined at the Horse Shoe bend of Little Vermilion, five miles above Newport, Indiana, with a thickness of from four and a half to five feet, and a heavy limestone roof. Further south we find its equivalent in the seam worked near the Indian Furnace, on Brouillet's creek and its branches, west of Clinton, Indiana, and also at the base of the hills north of the National road, opposite Terre Haute.

Immediately below this seam, and properly forming a constituent part of it, though separated near Danville by a variable thickness of fire-clay, is the so-called "Blacksmith's seam," of from ten inches

to two feet of good coal. Though the separation increases rapidly as we ascend Salt Fork, it is probably only local, and the partings are not likely to attain anywhere the dignity of distinct seams. In the Catlin shaft the division is not noticeable, except by the more ready separation of a few inches from the bottom of the main seam in mining. At Georgetown and southward, no such division is noticed.

Both the thickness and the character of the strata between this and the "Grape Creek" seam, No. 34, vary considerably. Along the Big Vermilion, especially in the neighborhood of Danville, we have generally from twelve to fifteen feet of fire-clay, rarely with nodular limestone and soft shale, the latter partly sandy, underlaid by a very compact layer of limestone, partly siliceous, partly nearly pure, which contains some fragmentary fossils, but nothing characteristic. Below this, and forming the roof of the lower coal, No. 34, we have a few feet of a dark drab, sometimes black shaly clay, in which no fossils were noticed. Though the different beds vary as indicated in the section, the whole thickness in this part of the county rarely exceeds twenty feet, and is often not more than sixteen feet. Along Grape creek, just below the distillery on the northwest corner of section 33, township 19 north, range 11 west, the lower seam is covered by three or four inches of soft black shale, followed by from twenty to thirty feet of drab clay shale, becoming sandy above, which, two hundred yards below, are replaced by a heavy bank of sandy shales and shaly sandstone, with some solid bands of quarry rock. I was unable to decide from the partially covered outcrop whether this was simply a change in the character of the layers, or whether the shale had been removed and the sandstone deposited in the eroded basin. At least forty or fifty feet of strata are here exposed above No. 34, without bringing in any representative of No. 27. Along the creek, above the distillery, there are indications of a low anticlinal, with confused dips, and I was at one time inclined to refer to the "Grape Creek" seam proper, the coal mined at and near Lafferty's, which here shows characters and accompaniments intermediate between those of coals Nos. 6 and 7; but the weight of evidence finally turned in favor of No. 7.

Along the Little Vermilion, below Georgetown, the intervening strata have thickened up still further. It would be difficult to measure an exact section, but the following is approximately correct:

	Feet.
Coal No. 7	2 to 3½
Fire-clay	6
Micaceous shale, some fine sandy, with few nodules of argillaceous limestone	10 to 15

	Feet.
Sandy shales and shaly sandstones, some quarried	30 to 40
Drab clay shales, with large ironstones	15 to 20
Drab clay shales, with small ironstone nodules and bands	30 to 40
Fine-grained, micaceous, carbonaceous clay shales	10 to 15
Fine-grained, micaceous, carbonaceous clay shales, with flat nodules and thin bands of ironstone; bottom darker, with *Leaia* and fern leaflets	12 to 15
Coal No. 6	4

This outcrop of the lower seam of coal is reached about three miles below Georgetown, near the northeast corner of section 3, township 17 north, range 11 west. The roof shales are in places crowded with the separated compressed valves of *Leaia tricarinata*, accompanied by a few scattering fragmentary fronds of ferns. The *Leaia* was found abundant, in the same position, upon Yankee branch, in section 14, of the same township. It is also found uncompressed, but in less abundance, in some of the small ironstone nodules of the overlying beds, where it accompanies considerable numbers of ferns, among which are found *Neuropteris hirsuta*, *N. vermicularis*, *Pecopteris Bucklandi* (!), *P. oreopteridius*, *P. villosa*, *P. Miltoni* (?), *Odontopteris Schlotheimi*, together with *Stigmaria ficoides*, *Sigillaria Brardii*, *S. monostigma*, *Lepidophyllum majus*, *Lepidodendron rugosum*, *Legidostrobus variabilis*, *Calamites approximatus*, *Asterophyllites*, and *Equisetites* (?). One nearly perfect insect found here, probably belonging to the genus *Miamia*, is in the collection of Dr. J. C. Winslow, of Danville. This same bed of nodules, containing the same set of fossils, excepting that the *Leaia*, has not been noticed, outcrops on the bank of the Wabash, at Durkee's ferry, about six miles above Terre Haute. In the southern part of this range the roof of the coal is black bituminous shale, often slaty, three or four feet thick, accompanied by huge concretions of pyritous ironstone.

No. 34 is apparently the equivalent of coal No. 5 of the Illinois Valley section. Along the Wabash valley its outcrop is nearly continuous from above Danville to where it dips under the river between Clinton and Durkee's ferry. Its thickness is variable; about Danville, sometimes less than four feet; two or three miles farther south, five to six feet; on Grape creek and its branches, five to seven feet; on the Little Vermilion, near Georgetown, four feet; at the Horse Shoe, above Newport, five to seven feet; near Clinton, five to six feet. It is generally a free burning coal, much freer from sulphur than the upper seam, and better liked for domestic use. Along Grape creek there is a thin clay parting, about four feet from the top of the seam, analogous to that in the upper seam. I cannot say whether this is constant further north; further south, it is generally present through-

out the outcrop. In the northern part of its outcrop this seam is capped by from six to ten inches of cannel, but this character is not common.

The fire-clay No. 35 is, in some places, very largely developed, as on Trosper branch, about four miles northeast of Georgetown, where, below the opening of the coal seam on the northeast quarter of section 22, township 18 north, range 11 west, I measured fifteen feet of clay in several alternating bands, with from three to four feet of nodular, argillaceous limestone, and was not certain that I had then reached the bottom of the bed, since the outcrop below was not exposed. The clay is here much variegated with streaks, blotches and beds of light-blue, dark-drab, dark brick-red, crimson and purplish tints, the red portions furnishing the boys with an unlimited supply of "Keel." The accompanying nodular bands of limestone occasionally contain fragments of fossils, but nothing characteristic. Possibly some of the lower of these bands may be the practical equivalent of the fossiliferous limestones at the Slip bank, below the Horse Shoe of the Little Vermilion, which, however, lie some thirty feet below the coal seam, the intervening beds being mainly fire-clay and shales, with some sand and a few ironstones. The nodular limestones accompanying the fire-clay of this seam, at Pettys' ford of the Little Vermilion, about four miles below Georgetown, have recently been found to contain considerable numbers of small land-snails of two species—one apparently identical with the *Pupa vetusta* of the Nova Scotia Coal Measures, and the other possibly a *Zonites*, but smooth.

The beds numbered 33 in the section are exceedingly variable. The upper layers, which are generally rather soft, contain, near and opposite Danville, from one to five bands of a very hard, calcareous sandstone or siliceous limestone, varying from six to eighteen inches in thickness. Where exposed to the weather, these are very hard and tough, but are softer below the surface. Perhaps fifteen feet below the level of the floor of the coal, we find at Leonard's quarry, a mile or so below Danville, a thick bed of gray, highly ferruginous sandstone, which is in much favor as a building stone. The bed is not constant, running into sandy shale within a short distance. The lower beds of this member of the series are all soft shales, of no practical value, and are entirely destitute of fossils. For some distance below Danville they form a set of high bluffs, reaching seventy or eighty feet at least.

After passing below Kyger's mill, near the mouth of Grape creek, the black limestone and shales of Nos. 35 and 36 come above the

water, and continue to form the prominent feature of the river banks to below the State line. They deserve notice only as indicating the level of coal No. 5, which is here wanting, though it begins to make its appearance at White's mill, on the Little Vermilion, four miles above Newport, with a thickness of four inches, and continues along the outcrop southward, with a general thickness of ten or eleven inches, nearly to Clinton, where it dips below the river level. At Hawley & Hett's bank, on Norton's creek, about four miles above Clinton, it is locally thickened up to from twenty inches to two feet. The overlying shales, through all the crop, are generally quite full of the conical bony teeth, or dermal scales of *Petrodus occidentalis*, constantly accompanied by the long, slightly curved and fringed fin-spine, and the small rhomboidal scales which there is every reason for referring to the same species. The accompanying black ferruginous limestone commonly contains more or less of the same fish remains, accompanied by *Cardiomorpha Missouriensis*.

The beds of the lower part of the section show no outcrop within this county, but, as they will very probably be met with in any moderately deep borings which may be made near the State line, east and northeast of Danville, it was thought best to complete the section as far as possible; and some general statements regarding these lower beds may not be out of place here.

No. 43 is a valuable bed of low grade ironstone. No. 44 generally contains a heavy band of tolerably compact sandstone, such as forms the Hanging Rock on the Big Vermilion, a few miles below the State line. No. 46 commonly presents two or three, and sometimes four or five partings of coal, separated by shale and fire-clay, some of which are occasionally thick enough to work profitably. No. 49 is too thin a seam to command attention, until nearly the entire supply of the tolerably thick seam in the neighborhood has been used up. It outcrops along the Big Vermilion below Eugene. No. 53 is a thick seam of semi-block coal, tolerably well fitted for smelting iron in the raw state. Two or three seams of coal occur below this, at Thorne's ferry, just below the mouth of the Big Vermilion, but, as their extent and regularity are unknown, and they are not represented at the point where the bore of the salt well was put down, it was thought best to omit them from the general section. They probably represent partings of coal No. 1. Below all these coals, but not represented in the section from lack of certain connections, is the heavy bed of limestone, with underlying shales, at Perrysville, Ind. These beds are full of fossils, and it is interesting to note that among them are some of very wide distribution,

such as *Athyris subtilita, Petrodus occidentalis,* and *Aviculopecten rectilaterarius,* the latter of which was formerly considered especially characteristic of one seam, but which presents itself to the explorer in every one of the black shales of the general section, from this basal bed to No. 4 of the section.

Economical Geology.

Coal.—After the fertile prairie soil, which has been already spoken of, this mineral naturally occupies the first place in an enumeration of the natural resources of Vermilion county. Two heavy seams underlie the larger part of the southern half of the county, both of which could be worked, at depths varying from nothing up to probably nowhere more than three hundred and fifty feet in all that portion of the county west of a line passing north and south through Danville, and south of the north line of township 19 north, with the exception of about one section in the northwest corner of township 19 north, range 11 west. Both seams are constantly present along the entire outcrop, and there is reason to believe that both will be found of workable thickness at all points where their level shall be reached in the county.

The upper seam is largely worked at and near Danville, both in shafts and strippings. At this point it has more than twice the thickness of the lower seam, and is accordingly made a source of supply, although of inferior quality. This fact, together with the carelessness of the miners, in not duly separating the slaty and pyritous portions of the seam from the good coal, has tended to impair the reputation of the coal of this county. As a fair estimate of the character and value of the coal, I append the following letter from Maj. Joseph Kirkland, now of Chicago, who has owned and worked coal mines in this region for many years:

307 Huron Street, Chicago, December 25, 1858.

Prof. Frank H. Bradley, *Assistant Geologist of Illinois:*

My Dear Sir: The coal of the main Danville seam is a strong, fat, soft, caking coal, averages six feet thick, lies nearly level, dipping say ten feet per mile toward the southwest; is hardest and most impure in its lowest stratum of eight inches or so; purest and best in the "blacksmith coal" stratum, one and a half to two feet next above, and more and more friable as you near the roof. The seam contains probably quite as much sulphur as other Illinois coals, but it is in masses, thick layers or nodules, easily separated and thrown out, and therefore less of a detriment in use than would

be a smaller proportion more intimately associated with the body of the coal. The roof is generally not good in the workings so far explored. The coal at all the mines (say six miles apart at farthest) is nearly equal in quality, though harder and therefore better in proportion to its distance from surface and outcrop. Its money value in general markets is about ten per cent. less than the best Illinois coal, and say fifty per cent. less than the best bituminous coal mined in the country.

There is no doubt as to the existence of two seams of coal at and near our workings. The main one is that we are working, and is that I have described. The second is from one foot to two or more in thickness, and is about sixteen feet below the upper, at our mine. You can see it at many bluff exposures on the Vermilion; also, in the well which supplies our mine engine with water. The mooted point is the existence of a third seam reported, at say eighty feet below the upper seam, by the traditions of the old salt works borings; which legend also reports it to be sixteen feet in thickness.

Some geologists (Col. J. W. Foster, of Chicago, for example) have concluded that there is such a seam, and that it is identical with the "Grape Creek" coal, a development six miles or so south of Danville, of a superior quality of coal. The Chicago and Carbon Coal Company sunk an experimental well (under my superintendence) starting in the ravine at a point about twenty feet below the working seam of coal (below the second seam) and prosecuted down some eighty feet, finding no coal; nothing but a continuation of the pale, sandy shale, hard while *in loco*, but disintegrating on exposure.

From the result of my observations and experience, and the absence of any known outcrop, northeast of the outcrop of the main seam of Danville coal, I am disposed to conclude that there is no such seam as the "third seam," reported from the "salt works" borings; or, if any seam exists at or near the locality and depth described, it is the thin "second seam"* I have spoken of, thickened up and become more distant from the main seam in the six miles intervening distance. At one place (just at the low-water level of the Vermilion) on the north (left) bank of the "Salt Fork" of the Vermilion, about two miles above Danville, that "second seam" shows a well defined stratum of "block" or "cannel" coal. I think I called your attention to this part of this seam.

---

* The solution of this problem is found in my remarks upon the two seams on the previous pages. F. H. B.

The main defect of the Danville coal is its friability and tendency to disintegrate or "slack" on exposure. It is a strong steam coal, and answers a very good purpose for all domestic uses.

Yours truly,

JOSEPH KIRKLAND.

Of analyses of coal from different openings in this seam, made some years since, and published in 1858, by Dr. NORWOOD, in his Report on Illinois Coals, I give the following summary:

Specific gravity	1.213 to 1.2833
Average	1.2563
Moisture	3.4 to 8.6
Average	7.13
Volatile matters	40.1 to 42.3
Average	41.85
Carbon in coke	40.5 to 48.96
Average	45.96
Carbon in coal	49.8 to 55.5
Average	51.576
Ash	2 to 16
Average	7.25

Gray, bluish-gray and grayish-white

The principal openings from which the coal of this seam is now shipped, are the drifts of Messrs. Chandler & Donlon, and Kirkland Bros., on the bank of the Big Vermilion, opposite Danville, and the several shafts along the T. W. & W. R. R., as far west as Catlin. The mines of the Carbon Coal Company, about two miles above Danville, along the river, were formerly extensively worked, and shipped their coal by a long branch track; but they are now deserted.

All the openings along the North Fork and its branches are on this seam, the lower seam being in all cases apparently thin and unprofitable. The last outcrop seen in ascending this fork is in the banks above Baldwin's old mill, in section 31, township 20 north, range 11 west, where the lower seam shows at the top of the bluff, but is apparently not worth working. It is worked, however, with a thickness of about four feet, at Leonard's mine, below the city, the last show of either seam in going eastward.

The openings along Salt Fork, as far as the west line of township 19 north, range 12 west, are all in the upper seam, though, for two or three miles above Danville, the lower seam is exposed in every bluff, and in some cases with a thickness of four feet or more. Up Middle Fork, the upper seam has never been fairly opened, though small quantities of coal have at times been taken from the bed of the stream for local use, and it could be mined at about that level as far north as the north line of section 8, township 19 north, range 12 west, but the sudden dip previously mentioned here, carries it

downward to probably one hundred feet below the level of the stream, and it does not again appear in going northward.

The lower or "Grape creek" seam is comparatively thin at Danville, in some cases not exceeding three feet,* and accordingly has not been worked sufficiently to ascertain its quality with certainty; but, on Grape creek, it has been worked by several drifts and strippings, with a thickness of from five to seven feet, and furnishes a superior coal. The portion below the clay parting would in most cases probably prove satisfactory, if used in the raw state for smelting iron. If nearer to railroad transportation, these mines might fairly compete with any in the State. The coal still contains small portions of pyrite, and here, as elsewhere, it appeared to me that this mineral became more abundant as the seam became thicker. At Blakeney's mine, on Possum Hollow, a branch of the Grape Creek valley—the only mine in all this region where it is done—I found that care was taken to separate the pure from the impure benches of the seam, a difference of two cents per bushel being made in the price. As a consequence, much local trade was centering here and I heard it spoken of in distant parts of the county. The following is a detailed section of the seam at this point:

	Feet.	In.
Micaceous clay shale	8 to 10	
Pyritous coal	2	1
Pure coal		8
Pyritous coal	1	6
Soft, drab, shaly clay		½
Pure coal	1	
Pyritous coal	1	9
Fire-clay, with thin bands of nodular limestone	8	

Along the Little Vermilion and its branches, from about four miles below Georgetown to below the State line, there are frequent openings of this seam for local supply, but no extensive workings. The coal appeared good. If railroad facilities could be supplied to this part of the county, these mines would at once become of great value.

Two analyses of coals from this seam, given in the aforesaid report, are as follows:

Specific gravity	1.311	and	1.3127
Moisture	9.	and	6.4
Volatile gases	34.5	and	39.17
Carbon on coke	50.	and	48.93
Carbon in coal	58.8	and	53.
Ash (white)	6.5	and	5.5

*I have not seen it where so thin as stated by Major Kirkland.

This seam has also been opened along Trosper branch, on J. Ogden's land, in the northeast quarter of section 22, township 18 north, range 11 west, about three miles northeast of Georgetown. At the time of my visit, the openings had caved in, so as to prevent examination; and I was informed that the coal here contained too much pyrite to be valuable.

The only other coal openings in the county are the small strippings of the thin seams Nos. 5 and 11 of the county section, which I have numbered provisionally as coals Nos. 10(?) and 11(?), and whose character and distribution have been sufficiently described in the general description of the section. Small quantities of coal of very fair quality can be obtained here for local use, but the seams are not thick enough to make them of any economical importance.

Coal No. 8 does not appear at its proper level in the section of the rocks of this county, viz: under the limestone No. 21 of the section. Its only appearance in all this region is at the Horse Shoe bend of the Little Vermilion, in the west half of section 20, township 17 north, range 10 west, about a mile east of the State line, where it comes in suddenly with a thickness of from three to four feet, and a reported roof of black slaty shale. It does not continue to the southward, and there is no reason to expect that it will be found sufficiently developed to furnish any considerable amount of coal within the limits of Vermilion county, though small patches may be found in the region just west of the Horse Shoe.

Through the region between the Big and Little Vermilion, no coal seams have been developed; but there is every reason for believing that both "No. 7" and "No. 5" are in place under all the western portion of this area, except on the slopes toward and near the Little Vermilion, where "No. 7" can only be looked for high in the bluff. Where the State line crosses the Big Vermilion, the "Eugene" or "Hanging Rock" seam, No. 46 of the county section, is probably about fifty feet below the water-level, and, judging from the general dip of the rocks, should come to the surface, in going north, before we reach the railroad at "Illiana," or State Line station. In this region, however, the surface is unbroken, and no wells or borings have exposed the rock, the Alluvium and Drift being apparently rather deep. The "Hanging Rock" seam, however, even if found here, would not probably be thick enough to be worked with profit, in competition with the Danville mines. There is reason, however, for supposing that No. 53 of the section may be found in this neighborhood, at no very great depth, and this, if found, would be likely to yield considerable supplies of superior coal. No outcrops

were found which would give any certain data for locating it; but a boring of two hundred and fifty feet would fully test the matter.

From somewhere in this neighborhood, the outcrops of the various strata seem to turn more northwestward; but shortly after passing down the south line of township 20, on all the branches of the Big Vermilion, we find the Drift deposits beginning to thicken so rapidly as to conceal all outcrops farther north; so that we are left to conjecture for the possibilities of that part of the county. Furthermore, there are no outcrops in Iroquois county to give us any hints; and the knowledge of the beds to the westward is too limited to furnish any certain data. From what we know, however, I am inclined to think that the "Danville," or at least the "Grape Creek," seam could be found as far north as Higginsville, at a depth of perhaps one hundred and fifty feet, while the lower seams might be found at Rossville, at not over two hundred and fifty feet. But, with the Chicago and Danville railroad bringing coal from the Danville mines at low rates, it would be long before mines could be profitably opened at that depth, if the presence of the coal were ascertained. In the northwest part of the county, near and beyond Marysville, it would probably pay some enterprising man to bore for coal, unless the heavy bed of quicksand under the boulder-clay, which has caused trouble in Champaign county, should be met with. Its undoubted presence in the southwestern part of the county—a well at Dallas encountered it at eighty-nine feet—appears to be the only reason to hesitate about sinking shafts there for mining either "No. 7" or "No. 5," both of which seams probably underlie the whole of that part of the county.

An average thickness of eight feet of workable coal appears to be of a sufficiently low estimate of the two principal seams over their indicated area, which will include about three hundred square miles. At the usual estimate of one million tons per square mile for each foot of thickness, this would give 2,400,000,000 tons of available coal supply. With the probabilities above stated, as to the existence of workable seams outside of the limits here calculated for, it would be a very moderate estimate to increase these figures to 3,000,000,000 tons, which, at the average price at the mine of $1.50 per ton, would yield to the county $4,500,000,000; and, by rise in value, the actual receipts will probably much exceed this.

The present shipment and consumption of coal from all the mines of the county is estimated by Col. W. P. Chandler, of Danville, at about 75,000 tons per annum. At that rate the supply will last only 4,000 years; and the consumption is increasing. Alas! for our descendants.

As already stated, the "Grape creek" seam, "No. 5," has, in some parts of the county, a cap of a few inches of cannel. Loose fragments of this have caused some profitless explorations for a seam of that material.

Lime.—All the lime now used in this county is brought from a distance, principally from Indiana. Along the railroads there is no bed of limestone in the county, but at Big Spring, less than two miles from Fairmount station, there is an abundant supply of limestone, the larger part of which is suited for making lime. Small quantities have been burned here in former years. At this point, it is true, there is no wood for fuel, but a shaft not over three hundred feet deep would furnish an abundant supply of coal for this purpose, while at the same time supplying a stretch of country which will soon furnish a large market for fuel. This is an especially favorable point for a shaft, having the rock all the way from the surface, and thus avoiding the heavy bed of quicksand which would probably make trouble farther to the southward and westward. A little enterprise would make Fairmount the center of a large trade in both coal and lime. Several kilns have been burned along the upper course of the Salt Fork from the drifted fragments of this bed.

The large drifted masses of Silurian (?) limestone which are quite numerous in the neighborhood of Mann's chapel and Rossville, have furnished, and will still furnish, small quantities of lime for local use. Small supplies could also be obtained from the outcrops of No. 21 of the county section, at and near Rock ford on Salt Fork, and at Swank's mill on Little Vermilion. The deposits of tufa from the springs near Danville are not sufficient in quantity to be of any value.

Building Material.—Coal Measure sandstones are proverbially unreliable as building material; still, at three points in this county, considerable quantities of apparently solid sandstone can be obtained. Danville is at present supplied, for foundations and to a small extent for superstructures, from Leonard's quarry, about a mile below the city, on the river bank. The best stone is of a rather coarse grain, somewhat vesicular, and stained in spots with oxide of iron. It appears to be a permanent stone. The beds do not continue solid through neighboring portions of the outcrop, and the supply of stone is therefore precarious. The following is a section of the quarry as it appeared in May, 1868:

	Feet.	In.
Olive shale, with purple streaks		8
Coal		1
Purplish shale	5	4

	Feet.	In.
Gray sandy shale		2
Gray sandstone	16 to 18	
Gray and bluish shale		15

On the opposite side of the river, not far from the same level, in the lower part of the ravine of the branch which flows through Donlon & Chandler's strippings, I observed four or five thin irregular bands of a very compact, highly calcareous sandstone, of very irregular fracture, which are said to have furnished some stone for the piers of the T., W. & W. R. R. bridge. They appear solid in the outcrop, but the quantity is small, and the irregular fracture would interfere with ready working.

On Makemson's branch, as before mentioned, there are some heavy beds of ferruginous sandstone, which appear better fitted for resisting the action of the weather than any other stone in the county. They are underlaid by softer beds, which have been washed away by the stream, so as to leave the upper beds projecting many feet in some cases. They may be found somewhat soft in quarrying, but will harden upon exposure and make a permanent stone, unless they are quarried so late in the season as to freeze before the quarry water is dried out of them.

Along Salt Fork, below Conkeytown, a layer near the bottom of No. 2 of the county section has yielded small quantities of very solid, calcareous sandstone, apparently permanent. Above this point, stone has been quarried at several places. Davis' quarry, in section 31, township 19 north, range 13 west, is the only one now open. The stone is soft in the quarry, but is said to become very hard and durable upon exposure, in consequence of the cementing quality of a small quantity of oxide of iron.

The limestone near Fairmount, so far as now exposed, is too shaky to be suitable for building. The upper layers of this bed in Edgar county have furnished some good stone for rough uses, and possibly corresponding beds may yet be developed here, especially at the southern extremity of the outcrop.

The drifted masses of Silurian limestone, in the north part of the county, are still sufficiently numerous to be mentioned as a source of building stone for that region.

The clay sub-soil throughout the timber will furnish abundant material for brick-making, and small quantities are mannfactured at several points. The yard of Perry Fairchild, at Danville, is especially worthy of mention. It furnishes from three to four millions of brick per annum.

Fire-clay.—As already stated, this article exists in very large quantities below both of the principal coal beds, especially the lower one. The greatest development noticed is on J. Ogden's land, about three miles northeast of Georgetown. No use has been made of it thus far, but it is well deserving of attention.

Iron Ore.—Along the banks of the Little Vermilion, for some miles below Georgetown, large quantities of nodular carbonate of iron are scattered and piled. The quality of the ore is not constant, but I judge that the larger part of it would yield from twenty-five to thirty-five per cent. of metal. The layers are so scattered in the shale and so irregular in thickness that no proper estimate of the quantity can be made; but, judging by the eye, there must be nearly or quite as much ore here as at the locality on Brouillet's creek, in Edgar county, which for years furnished an abundant supply of ore for the Indiana furnace, without any signs of giving out. On the Big Vermilion and its branches, just below the State line, I found a pretty constant band of a calcareous carbonate of iron, varying from one and a half to three feet in thickness, which may, at some points near Browntown, outcrop within the limits of the county. Upon the whole, there appears to be enough ore to warrant the erection of an iron furnace somewhere in this region, whenever a railroad shall furnish the requisite transportation.

Zinc blende has been found in small quantities in some of the ironstone nodules of the Little Vermilion, and small quantities of this mineral, disseminated in small grains through an ironstone just below coal No. 5, at the Horse Shoe of the Little Vermilion, has caused considerable excitement over the supposed discovery of "silver." The quantity is nowhere of any importance in this region.

Gold is met with in small quantities in certain thin gravel beds which accompany the boulder clay, but not in sufficient amount to be anything more than a periodical source of excitement to the ignorant.

Several large masses of *Native Copper* have been picked up in the Drift beds of this county. It is needless to say that they do not indicate any valuable deposit of this metal at any point nearer than the mines of Lake Superior, whence they have drifted. Here, as elsewhere, "the Indians" are credited with the knowledge of valuable lead mines in this region.

Salt.—Springs feebly impregnated with salt are known at several points in this region. The most notable is near the junction of

Middle and Salt Forks, in section 16, township 19 north, range 12 west, where, during the early settlement of the country, a well was bored to a considerable depth, and salt made in large quantities. The following account of the work done here was taken from the lips of Harvey Luddington, Esq., of Danville, who was engaged in the work for some years:

The well was begun in 1819 by a small company, of which Messrs. Blackman, Treat and Beckwith are remembered as the principal members, and deepened at intervals. The following is given as an approximate section of the materials passed through:

	Feet.
1. Alluvium	19
2. Coal No. 7	2 to 2½
3. Blue fire-clay	3 to 4
4. Shale	90 to 100
5. Coal* and shale No. 5?	16
6. Fire-clay	?
7. Very hard gray rock	69
8. Soft clay shale	175 to 200
9. Soft clay shale?	75 to 100

The thinness of the upper coal is evidently due to a partial wearing away of the seam by the current of the river before the deposition of the Alluvium.

The first digging only passed through the fire-clay, and a brine yielding one bushel of salt to one hundred and seventy gallons of water was boiled at such a rate as to yield from forty to fifty bushels per week with eighty kettles. Below the lower coal a cavity of eighteen inches was found, from which flowed a much stronger brine, one hundred gallons of which gave a bushel of salt. The production was now about one hundred and twenty bushels per week, and the price $1.50 per bushel. In 1825 Major Vance bought the works and deepened the well, the boring being continued at intervals until 1827, but the strength of the brine did not notably increase. After the construction of canals and railroads, they were unable to compete with the Syracuse salt, and work was stopped

* The enormous thickness of this coal, as reported by the well borers, has always been a mystery to the coal miners, since no such bed appears upon the outcrop, and the boring referred to in Major Kirkland's letter did not reach any corresponding bed. It was long suspected that at least a part of this was shale, and the parties who bored an "oil well" at Rock Ford, on Salt Fork, report finding, at a considerable depth (amount not given) below coal No. 7, "twelve feet of black shale and four feet of cannel." If this report is correct, this is probably coal No. 5, the changed condition being only the result of the more complete action of the causes which gave to that seam, two miles above Danville, a top bench of nine inches of cannel. Until, however, some shaft has been sunk to this lower seam at some considerable distance west of the outcrop, I shall not be willing to believe in any such condition of things at that level.

and never resumed. The brine probably came from the sandstones at the base of the Coal Measures, and would have been found of greater strength if the well had been deepened considerably. From these lower beds, wells bored on the east side of the Wabash have obtained brine of a strength of from 7° to 8½° Beaume. It would seem that, with the abundance of coal on the spot, the reduction of this ought to be made to pay.

This abundance of brine in the lower strata makes it doubtful whether pure water can be obtained in this county by artesian wells sunk in the rock. In nearly all parts of the county, however, water can be obtained from the quicksand below the boulder clay, which, in most cases, will rise high enough to be readily pumped to the surface, and in some cases, in the north part of the county, flows out naturally, as in the numerous flowing wells of Iroquois county, which are probably supplied from the same source.

Road Material.—Along Jordan creek, about a mile below Fairmount, several strong springs flow from a heavy bank of very sandy boulder-clay, which is said to harden rapidly when exposed to the air. It would be worth while to try the effect of a good coating of this upon some of the prairie roads, making the application when the road is dry and smooth.

In working up the geology of this county, I have met with most cordial treatment everywhere, but can only express my great indebtedness to Dr. J. C. Winslow, of Danville, who, since the day I commenced work in the county, has done all in his power to forward my plans, and both during my stay there and since my departure, has constantly furnished me with needed information and specimens. The exigencies of the survey required me to extend my lines into the adjoining part of Indiana; and here I received the indefatigable assistance of Mr. John Collett, of Eugene, who, whenever called upon, has been always ready to put himself and all he possessed entirely at my disposal. I could wish no geologist better fortune than to fall into his hands. In this part of my work I was also very greatly assisted by Mr. William Gibson, of Perrysville, and Dr. C. P. Boyer, of Williamsport.

NOTE.—The coal No. 6, or "Grape Creek seam," of this county, seems to correspond much better in its general characters with No. 5 of the Illinois Valley section than the Danville coal, which Mr. Bradley suggests as its probable equivalent. Everywhere in Fulton and Peoria counties where No. 6 has been examined, it has a clay parting, usually a little below the middle of the seam, and varying from a half inch to two inches or more in width. The coal is also very free from pyrites, and is usually preferred for blacksmith's use, and has a well-defined "block" character. We see no objection to considering No. 7

in the Wabash valley as the equivalent of some of the thinner seams above No. 6 in the Illinois river section, which are there too thin to be of any value practically, and hence have been but slightly studied, and consequently their peculiar features are as yet but little known. So far as the specific character of the fossils of the roof shales can be relied on to determine the equivalency of the strata, there is a much closer resemblance between those found in connection with the Danville coal and the small seam overlying No. 6 in the vicinity of Springfield than with any of the lower seams.

A. H. W.

CHAPTER XXVII.

EDGAR, FORD AND CHAMPAIGN COUNTIES.

Edgar county lies adjacent to the eastern part of the State, and is bounded on the north by Vermilion county, on the west by Coles county, and on the south by Clark county. It is nearly a square, being about twenty-three and a half miles long by about twenty-seven miles wide, and thus containing something less than six hundred and forty square miles.

The eastern and southern borders of the county, comprising, perhaps, two-fifths of its area, are occupied by the timbered land adjoining the breaks of the streams which run towards the Wabash. The remainder, with the exception of a few sections about the head of Embarras river, in the western edge of the county, is occupied by the Grand Prairie, some arms of which also run quite deeply into the timber, along the divides between the different creeks.

The timber is mainly the same as that of the timbered lands to the northward; but in the southeastern part of the county, beech begins to take a prominent place, and considerable numbers of pines find congenial soil above the heavy-bedded sandstones which form the bluffs of the Barren fork and its branches, in the edge of Clark county, south of Grand View.

The prairie generally has a deep black mucky soil, but, in some of its eastern extensions into the timber, this is mostly wanting, and the soft dark-brown clay of the sub-soil comes nearly to the surface. The bottoms of the prairie sloughs generally contain more or less light-brown marly clay, containing fresh-water shells. From one of these slough bottoms a nearly perfect skeleton of a Mastodon was obtained some years since, which, having been exhibited through all this part of the United States, is said to have been sold to a Philadelphia museum. Fragments of skeletons of this animal are not rare hereabouts.

The beds of the Drift period do not show any very great thickness in this county, and only the boulder-clay member is well developed. They may perhaps attain a depth of one hundred feet in the northern part of the county. Where any considerable quantities of these materials occur, they are generally underlaid by a heavy bed of water-bearing quicksand, apparently continuous with that found in Champaign and Vermilion counties in the same position. This was encountered at Grand View in 1869, at a depth of fifty feet, in the shaft attempted by Messrs. Holding in search of coal.

Rock Formations.

The rocks exposed within the county all belong to that portion of the Coal Measures which lies above coal No. 5 of the Illinois Valley section, or No. 7 of the Wabash Valley section, as given in the report upon Vermilion county. Above that level no workable seam of coal is developed in this region. Immediately upon the borders of the county, however, we find the outcrop of Nos. 7 and 5 is not far below. Both seams are probably workable by shafts in all parts of the county.

For the readiest understanding of the geology of the county, I give the following general section:

		Feet.
1.	Soft clay shales	40
2.	Coarse sand-rock and shales, with limestone bands	95
3.	Limestone, bottom often shaly	25
4.	Green, dark-drab and black clay shale (level of No. 12?)	3 to 4
5.	Greenish shaly sandstone and sandy shales	12 to 15
6.	Green and drab clay shales	30 to 40
7.	Light-drab and greenish, very ferruginous sandy shales	15 to 20
8.	Dark-drab clay shale, with few large ironstones	5 to 6
9.	Impure shaly coal "No. 9?"	1¼
10.	Greenish clay shales	8 to 10
11.	Sandy argillaceous limestone, containing pebbles of black limestone, and fragments of fossils	1½ to 3
12.	Red and green, changing to green sandy shales and shaly sandstones, locally heavy-bedded, containing *Caulerpites*, and graduating below into	10 to 15
13.	Green and drab clay shales, with ironstones very numerous at bottom	30 to 35
14.	Marly argillaceous limestone, with fossils	½ to ½
15.	Soft black shale	2
16.	Coal "No. 8?"	½ to ½
17.	Fire-clay	3 to 4
18.	Light-drab sandy shales, weathering greenish, with heavy ironstones	40 to 50
19.	Dark-drab shales, weathering greenish, coarsely concretionary	12 to 15
20.	Light-blue clay shales	15 to 20
21.	Coal, top shaly, "No. 7"	5 to 6
22.	Fire-clay	6 to 8
23.	Sandy shales	10 to 12

		Feet.
4.	Limestone	1 to 2
25.	Sandy shales	8 to 12
26.	Compact sandstone	3 to 6
27.	Greenish sandy shale, with few ironstones	25 to 30
28.	Black shale, some slaty, with very heavy pyritous ironstone nodules	5 to 6
29.	Coal "No. 5"	5 to 6
30.	Fire-clay and soft clay shale	4 to 6

Nos. 1 and 2 of this section are here given in general terms from the report of the boring at Sutherland's distillery, two miles north of Paris. The outcrop of the corresponding beds on Sugar creek, the only point where they were seen, is so disconnected that a detailed section cannot be made. With the exception of the limestone bands of No. 2, of which I can find no trace along the outcrop, I am inclined to accept them as generally correct. Apparently belonging near the top of No. 2, I found at two or three points, about three inches of shaly coal, overlaid by from one to feet of black, slaty shale, with pyritous nodules apparently of coprolitic origin, though no fossils were seen. Of the shaly sandstone next beneath these beds several layers will yield very fair-sized flagstones, though they do not appear very durable. The coal must represent seam "No. 13," according to the numbering adopted in in these reports for the Wabash valley coals.

The bed of limestone numbered 3 in the section was reported as being twenty-five feet thick in the boring. The best outcrop seen is at the Roman Catholic church, one mile east of Baldwinsville, where a small stream runs over and exposes twelve or fifteen feet of its lower layers. These are partly compact, partly shaly, and, near the base, contain several thin layers of green, shaly clay. Fossils are tolerably abundant, but only of the most common species. The higher layers of this bed are more solid, and have been quarried for culverts and foundations at several points near the southeast corner of township 14 north, range 11 west. The lower layers have been quarried to a small extent near Mr. Clinton's, on Lane's branch, in the northeast quarter of section 5, township 13 north, range 11 west. They are here also quite thin and with shaly partings, and contain great numbers of fine fossils, such as *Athyris subtilita*, *Spirifer cameratus*, *S. lineatus*, *Meekella striato-costata*, *Pleurotomaria turbiniformis*, *Cyathaxonia proliferum*, *Heliophyllum* (?), plates and spines of *Palæchinus*, etc. On the main branch of Sugar creek there is no exposed outcrop of this bed, though the large masses of it lying in the bed of the stream, a short distance above the railroad bridge, may be considered as indications that the bed is not far off.

Tumbling masses of this rock are also seen in considerable numbers just at the county line, on Big creek, but no outcrop was detected in this neighborhood.

On Barren Fork of Big creek, at the Big creek mill, in the southwest quarter of section 1, township 12 north, range 13 west, the same bed outcrops, with nearly the same fossils as on Lane's branch. Not more than ten feet of the lower shaly portion of the bed is here exposed. In descending this fork we come to shaly sandstones, which, near the county line, and especially in the neighboring part of Clark county, give place to very heavy-bedded sandstones, forming abrupt banks and cliffs of from ten to perhaps forty feet in height. The connection between these beds and the limestone was not exposed, and the dip was not strongly enough marked to decide their relations; but my impression at the time was that the limestone was the higher bed. I will not, however, insist upon that interpretation of the facts, since it in no way affects my determination about the overlying beds, and Prof. E. T. Cox, who surveyed Clark county, though confessing that he nowhere saw the direct connection of the two sets of beds, is very strongly of the opinion that the sandstone is the higher.

From the Roman Catholic church before mentioned there is an almost continuous outcrop down Brouillet's creek, as given in the section, until we meet the first workable coal seam just below the State line. A similar section is exposed up on Coal creek, two or three miles farther south, which joins Brouillet's creek at the Indiana Furnace. On both these streams, Nos. 13 and 18 furnish large quantities of iron-stone nodules of fine quality.

No. 11 of the section, with its numerous pebbles of black, bituminous limestone, furnishes a readily-recognized horizon for some miles along the creek, near and below Baldwinsville.

No. 12, although quite variable in character within short distances, is noticeable for containing the *Caulerpites marginatus*, which marks the same level along the Salt Fork in Vermilion county.

No. 14 contains a few fossils in good preservation, such as *Spirifer lineatus*, *S. plano-convexus*, *Spiriferina Kentuckensis*, *Pleurotomaria sphærulata*, *P. Grayvillensis*, *Productus longispinus*, *Cyathaxonia proliferum*, *Astartella*, etc.

The coarsely concretionary structure of No. 19 allies it with corresponding beds in Vermilion county, which there lies perhaps thirty feet higher than coal No. 7.

With the exception of the limestone No. 3 of the section, whose distribution has already been spoken of, the small outcrops along

the stream in the southern part of the county are so disconnected and of such common characters, that it would be next to impossible to determine their exact equivalents in the section. On Clear creek, in the northwest quarter of section 7, township 12, range 11 west, a few feet of a soft, fine-grained sandstone, somewhat ferruginous, has been quarried to a small extent, principally for grindstones. It is underlaid by four or five feet of very dark-drab clay shale. This may be the equivalent of No. 12 of the section, but I am rather inclined to believe that No. 7 has here taken the form of a sandstone. In either case, it is not impossible that the report may be correct, that coal was struck at eighty feet, in a boring made in this neighborhood some time since. The shales and irregular shaly sandstones, which outcrop just at the railroad bridge over the main branch of Sugar creek, evidently belong to Nos. 4 and 5 of the section. In going down this creek we find no beds of rock evidently in place, except about a mile north of Elbridge, where two or three feet of soft, drab clay shale make their appearance at two or three points, but give no indication of their position in the section. Upon the streams west of Big creek, in the southwest corner of the county, and about the head of Embarras river, in the western part of the county, no rock outcrop could be found.

The boring at Sutherland's distillery seems to have been put down at nearly the highest point in the county, geologically speaking; and a carefully prepared record of it would aid very greatly in the determination of the geology of the county. Such a record was kept by Dr. Newell, of Paris, but was unfortunately lost in the burning of his store, and only general facts have been preserved by memory. It is stated, however, that one hundred and thirty feet of strata were found between the limestone No. 3 and the first workable coal, and about one hundred feet between this and the next one, below which no coal is reported. It would be queer if none of the lower seams should run under here; but two five-foot seams are enough, for several generations at least.

The following is reported as the section of a boring made at Sandford's Station, in May, 1867:

		Feet.	In.
1.	Soil and subsoil	15	
2.	Sand	6	
3.	Sand and clay	4	
4.	Hardpan	66	
5.	Brown clay	10	3
6.	Blue clay	8	4
7.	Sandstone		4
8.	Blue clay	37	2
9.	Black shale	1	3
10.	Fire-clay	4	5

		Feet.	In.
11.	Limestone	6	5
12.	Red clay	2	
13.	Limestone	3	
14.	Soapstone	2	8
15.	Limestone		9
16.	Red slate	7	6
17.	Hard-pan	2	9
18.	Limestone	3	
19.	Sand and clay	4	
20.	Limestone	1	9
21.	Red slate	1	6
22.	Sand and blue clay	5	3
23.	Sandstone	3	10
24.	Black slate	8	3
25.	Hard stone		5
26.	Black slate	4	2
27.	Bastard lime		8
28.	Slate	7	5
29.	Soapstone	5	3
30.	Rotten coal	4	7
31.	Sandstone		6
32.	Fire-clay	7	2
33.	Sandstone	4	
		239	7

The black shale of No. 9 of this section apparently represents coal "No. 7," while Nos. 24 to 26 may represent coal "No. 6." No. 30 may possibly be a parting of "No. 6," locally separated from the same seam. There are spots in every coal seam where the coal is wanting, and this boring, if correctly reported, seems to have been sunk at a point where this is true of both seams. It is possible that the seams do not extend under the southern part of Edgar county; but I do not believe this to be true. I put no faith in the reports of the sections obtained in sinking several oil wells in the northwest corner of Clark county and the southeast corner of Coles county, most of which, as reported, contain no coal. I judge that coal can be found under every section of the county, at a depth nowhere exceeding three hundred and fifty feet; and along the line of the railroad, two hundred and fifty feet would probably reach the first seam of coal, "No. 7," in nearly every case; the most doubtful point being at Paris. The distance from "No. 7" to "No. 5," is reported at one hundred feet in the distillery boring; but this distance is probably about seventy feet on Brouillet's creek, and less elsewhere. "No. 7" is quite impure in all this region, and, in shafting for coal, it would probably be best to go on to the lower seam, No. 5, which is a much purer article, considerable portions of it being the so-called "block" coal, in most of its outcrops in this region. In consequence of the great variations in thickness in most of the beds exposed along Brouillet's creek, I have been obliged to give, in the general section, very variable thicknesses for nearly

every bed. In calculating from the section the probable depth to any particular bed, at any one point, the average of thicknesses should be used. I had hoped that before the publication of this report, at least one shaft might have been sunk, so as to determine the exact section at some one point, but the shaft proposed at Paris is apparently given up, and the one commenced at Grand View, by Holding Bros., has been temporarily stopped, through meeting with the heavy beds of water-bearing quicksand at the base of the boulder clay.

One kiln of lime was burned at Collins' quarry, on Lane's branch, but care was not taken to separate the shaly layers before burning, and the lime is worthless, except for agricultural purposes. Some portions of the bed No. 3 of the section would make good lime.

For courtesies and information while engaged in the survey of this county, I am especially indebted to John W. Blackburn, Esq., and to Dr. Newell, both of Paris.

CHAMPAIGN AND FORD COUNTIES.

These counties occupy a nearly central position in the State, measuring north and south, and lie in the second tier of counties from the Indiana line. They are near the center of the Grand Prairie, and have an almost exclusively prairie surface. The groves are few and small, and are situated upon the small streams which head in these counties.

Champaign county contains about ten hundred and eight square miles, being about thirty-six miles from north to south, and about twenty-seven from east to west.

Ford county consists of two parts, the one adjoining Champaign county, about fifteen miles from north to south, and twenty-seven miles from east to west; the other running thirty miles northward, between Iroquois and Livingston counties, to the south line of Kankakee county, with a width of only six miles.

So far as is known, there is no outcrop of rock within the limits of these counties. Scattered over their area, there are many large drifted masses of Niagara group limestone and Coal Measure limestone and sandstone. These are, in some cases, of very large dimensions, and have yielded considerable quantities of stone for local use; so that some persons have supposed them to be solid beds of rock. The evidence is, however, as we have stated, that no solid bed reaches the surface.

The soil is mainly the rich, black prairie muck, from one to five feet thick, underlaid, in most cases, by a yellow clay subsoil. Along the sloughs and ponds the subsoil is a tough, brown to yellow clay, with numerous small fresh-water shells of the genera *Physa*, *Lymnea*, *Planorbis*, *Cyclas*, etc. These are often so numerous as to give a whitish cast to the whole mass. We have not heard of the finding of any Mastodon remains in these beds, though they are not rare in similar situations in adjoining counties.

The subsoil is underlaid by irregular alternating beds of clay, gravel and quicksand of the Drift formation, to the depth of from one hundred and fifty to probably three hundred feet.

In an attempt to sink a coal shaft at Champaign, Mr. John Faulds found the following section:

	Feet.
Soil, clay and quicksand	17
Red and blue clay	73
Peat	2
Quicksand, containing a tree seven inches in diameter	9
Soft, yellow clay	9
Sand	3
Yellow clay	7
Quicksand and gravel	59
	179

The bottom bed of quicksand defied all his efforts to reach a greater depth. Within a short distance of this place, however, an earlier boring, of which we have not the data, is said to have reached soft, blue shale at one hundred and sixty-eight feet from the surface.

The depth and character of these beds correspond with what is known of similar deposits to the northward and eastward. We find in them evidence that, at some former period, some powerful denuding current has torn up the rocks and excavated a broad and deep channel, extending from the southern end of Lake Michigan down the eastern line of the State until, shortly after passing the line now occupied by the Kankakee river, it rose over the declining edge of the Niagara limestone, and then bore off southwestward through the softer beds of the Coal Measures, which here seem to lie directly upon the Niagara. This channel passes through the central and western part of Iroquois county, and includes large parts of Ford, Champaign and McLean counties, with the southeastern part of Livingston, where its western bank must be located between the two borings at Chatsworth, the western on the southeast quarter of section 4, township 26 north, range 8 east, near the east line of the section, striking the Coal Measure rocks at eighty-eight feet, and the

eastern in the southeast quarter of section 3 of the same township, striking no rock until it reached the green calcareous shales of the Cincinnati group at two hundred feet.

To the westward of Champaign county its course is not so well indicated; we know only that it runs under Bloomington, in McLean county, with a depth of two hundred and fifty-four feet. However, as we find at Rantoul and Champaign, points probably near the eastern side of the channel, and at Chatsworth, which we know to be on its western bank, only one "dirt-bed," or ancient mucky soil, noted as "peat" in the foregoing section, while at Bloomington we find two such beds well developed, one six and the other thirteen feet thick, I am inclined to believe that this point is near the centre of the old valley. I will further suggest that its junction with the valley of the Illinois will probably be found somewhere in Tazewell or in Mason county.

The erosion of this great valley, of course, took place before the Drift period, since the deposits of that age not only fill it completely, but deeply cover its banks, except at the few points where they have been removed in the course of the erosion of the present river valleys.

The gravel beds contain the ordinary variety of metamorphic rocks, with not unfrequent larger or smaller masses of galenite from the Galena region, and native copper from Lake Superior; but the larger part of the pebbles and rock masses consist of the Niagara limestone, or "Kankakee stone," and the shales, sandstones and limestones of the Coal Measures.

The sands and gravels of these beds furnish abundant supplies of water at moderate depths; and the white quicksand lying between them and the underlying rocks yields inexhaustible quantities, though generally at too great a depth to be readily pumped up.

Underlying Rocks.—The boring above reported as having reached blue shale at one hundred and sixty-eight feet, is said to have encountered, at one hundred and seventy-six feet, a bed of coal five feet thick, which is supposed to be equivalent to the Danville seam, "No. 7." As the synclinal axis of this part of the Coal Measures crosses the Salt Fork of the Big Vermilion river at Conkeytown, five miles east of the east line of Champaign county, with the Danville seam not far from two hundred feet below the surface, while the underlying beds begin to rise slowly as we ascend the river from that point, it seems not improbable that this seam may be found at the depth reported, but its existence there seems still uncertain.

It appears almost certain that the northern strip of Ford county is destitute of coal, but no boring has proved its absence in the southern portion of the county; judging, therefore, from the data obtained in the surrounding region, it seems probable that the whole of the district is underlaid by one or more workable seams of good coal, the uppermost probably lying *nowhere more* than three hundred and fifty feet below the surface, and generally at a much less depth. There appears, therefore, to be no good reason why shafts should not be sunk to furnish a home supply in place of that now transported from a distance. And, as both counties are crossed by the Illinois Central railroad, giving direct connection with Chicago, a ready market could be found for any surplus of this sole source of wealth, aside from those which are strictly agricultural. The heavy bed of quicksand which is said to rest directly upon the rock, under a part at least of this district, presents the only obstacle to easy mining; and this could be readily overcome by any engineer of ordinary skill.

It is reported that at Urbana, starting fifty feet lower than the surface at Champaign, coal was encountered at two hundred and twenty-five feet.

Borings made near Rantoul in 1857, whose results were then suppressed, are now said to have found, about half a mile south of the station, a nine-foot seam of coal at a depth of one hundred and twenty feet, having struck rock at a depth of eighty feet; and one and a half miles east of the station the same seam at one hundred and sixty feet.

The purity of the white, water-bearing quicksand which underlies the Drift calls to mind the character of the St. Peters sandstone at its outcrop in LaSalle county, in which region it supplies several large artesian wells. The southern continuation of the anticlinal axis, which brings this rock to the surface at that point, would pass not far from Champaign; and it is altogether probable that the aforesaid quicksand is really a part of the disintegrated outcrop of that bed distributed over the bottom of the great channel, which must have exposed it at some point in this region. It is also probable that the water which fills the quicksand comes from the edge of this bed.

CHAPTER XXVIII.

HENDERSON COUNTY.

Henderson county is situated on the western border of the State, and embraces a little less than eleven townships, or, about three hundred and eighty square miles. It is bounded on the north by Mercer county, on the east by Warren county, on the south by McDonough and Hancock counties, and on the west by the Mississippi river. The surface is much broken by the numerous streams passing through it. The principal one of these is the Henderson river, which enters the county near its northeast corner, and, passing in a southeasterly direction, empties into the Mississippi about six miles below Oquawka, tributary to the Henderson, and in the northern part of the county, are Fall, and North and South Smith's creeks. South Henderson creek enters the county on its eastern border, through the southern part of township 10 north, and running a little to the north of west, empties into the Henderson about a mile north of Sagetown. South of this the county is intersected from east to west by Ellison creek, which empties into the Mississippi about two miles north of Shokokon. In the southern part of the county there are Honey and Dugout creeks.

The prairies of this county are mostly small, and occupy less than half its entire area. The soil of the prairie is a deep, black loam with a brown clay subsoil. On the ridges, which skirt the streams, the soil is of less depth, and of a lighter color than that of the prairie. It is usually a dark-brown, loamy clay, becoming lighter brown on the slopes of the hills, and partaking more of the character of the subsoil. Formerly these ridges were, for the most part, timbered, but much of the timber has been cut off, and the process of denudation still goes on. The timber on these ridges is principally the common varieties of oak and hickory, with an undergrowth

of hazel and sumac. Along the slopes of the hills, and on the bottom lands of the streams, we find in addition to these, red and white elm, white, blue and prickly-ash, linden, sycamore, sugar and white maple, ash-leaved maple or box-elder, black walnut, butternut, buckeye, cotton wood, honey locust, American aspen, wild cherry, coffee tree, hackberry, mulberry, ironwood, wildplum, thorn, crab-apple, dogwood and redbud.

Between the bluffs and the Mississippi there is a belt of bottom land extending from the north end of the county to Camp creek, with an average width of from two to three miles. A portion of the soil of this land is a deep black loam, very fertile, and originally covered in part by a heavy growth of timber. Here we find black, white, red and pin oak, pecan, the common varieties of hickory and elm, buckeye, black walnut, butternut, sycamore, box-elder, etc.

Along this bottom land, and for nearly the entire length of the county, there runs a variable belt of sand ridge. It generally lies in low, rolling ridges, which, in some cases, become hills of thirty or forty feet in height. This belt passes irregularly through the bottom lands, here forming the river's bank, and then running nearly back to the bluff. In the northern part of the county it, in some places, attains a width of about two miles. The soil is mostly poor; still considerable portions of it are cultivated, and by proper manuring, yield moderately, though but few seasons are wet enough for it to produce largely. The timber is principally scrubby, and black-jack oak.

Springs are numerous in this county, and some of them are large and valuable, furnishing a constant supply of water, in quantities sufficient for the necessities of large herds of cattle. Good wells may generally be obtained at depths of from fifteen to sixty feet. Mineral springs are not uncommon, copperas being the mineral most commonly held in solution. One of the largest and best known of these is in section 32, township 11, range 4 west.

Surface Geology.

The surface deposits of this county comprise the three sub-divisions of the Quaternary System, Alluvium, Loess and Drift, and attain a thickness of from thirty to eighty feet. The largest alluvial deposit in this county is that along the Mississippi, but smaller belts are found along the smaller streams, especially Henderson river, South Henderson, Ellison and Honey creeks. These, however, are seldom over a half a mile in width, and frequently but a few rods. The

soil of these deposits is generally largely composed of vegetable mould, mixed with sand and gravel, and is very fertile. That along the Mississippi has been already described.

The Loess is a marly sand deposit, generally more or less calcareous, and usually containing large numbers of fresh-water and land shells, mostly of species still existing in this region. It frequently contains small concretions of carbonate of lime, which have resulted from the leaching of the mass. These were noticed in township 9, range 5 west. This deposit caps a portion of the Mississippi bluffs in this county, and is also found along South Henderson and Honey creeks. Elsewhere it was not noticed, though it is probable that it may be found in other parts.

The Drift comprises a series of brown, yellow and blue clays, locally intermingled with sand and gravel, with, in some places, thin beds of cemented gravel. These deposits are spread over the entire surface of the uplands, and when the Loess is present, underlie it. Bituminous coal in rounded fragments is frequently found in the Drift, and has been derived from the coal strata in the adjoining region. From these fragments, many have been led to suppose that valuable beds of coal might be found where they occur, and much time and money have been wasted in searching for them. They do not furnish any evidence, however, of deposits of coal in the immediate vicinity in which they occur. In section 23, township 8, range 6 west, just above the bridge, where the bluff road crosses the Dugout creek, considerable quantities of Drift coal has been observed. It is reported that, at one time, a sufficient quantity was obtained here to be used for blacksmithing purposes.

The other geological formations that occur in Henderson county are the Coal Measures, St. Louis group, Keokuk limestone, Burlington limestone and Kinderhook group.

The *Coal Measures* are found only in the southeastern part of the county. They are represented by a few thin beds of sandstone, shales, clays, and a single seam of coal, which has been found only in sections 23 and 26, township 9, range 4 west. It probably belongs to coal No. 2 of the Illinois river section, and at this point varies from one foot eight inches to two feet ten inches in thickness. In the south part of section 23, it is overlaid by a yellow sandstone mottled with whitish spots, which appear to be unfossiliferous. At the other mine, in the northeast quarter of section 26, this sandstone contains pebbles and fragments of carbonized coal plants, while in some parts of it there are nodules of fossiliferous limestone.

Among the fossils obtained here are *Spirifer planoconvexus, Athyris subtilita, A. Royissii, Rhynchonella Uta, Retzia Mormoni,* and *Terebratula bovidens.* The coal rests upon a bed of fire-clay, the thickness of which has not been ascertained. At this point the strata dip, at a slight angle, to the southwest, while in section 23 they dip to the northeast.

Sandstones resembling those of the Coal Measures have been found in various parts of townships 8 and 9, range 4 west; also near Biggsville. Thin outliers of the Coal Measure strata may also be present in other parts of the county, but deeply buried beneath the Drift, and would probably afford no coal of any value if found. Where the Drift is known to rest on the lower Carboniferous limestone, the search for coal would be useless.

St. Louis Group.—Beds belonging to this group have been recognized with certainty only along South Henderson creek, near Biggsville. At the time I visited this place (in the spring, 1868,) the creek was so high that many of the beds were covered, and others could be examined only with much difficulty. I am indebted to Prof. A. H. WORTHEN for the following section, which was made by him about a mile and a half southeast of Biggsville:

	Feet.
1. Loess	10 to 12
2. Gravel, sand and clay	12 to 15
3. Blue plastic clay, with pebbles	15
4. Quartzose sandstone	2
5. Band of broken, rotten limestone	1
6. Blue marly clay, stratified	15 to 20
7. Bands of broken magnesian limestone	1½
8. Keokuk beds	25 to 30

No. 4 of the section probably belongs to the Coal Measures, while Nos. 5, 6 and 7 belong to the St. Louis group. West of Biggsville it was again recognized in section 17. Commencing below the Drift, a section of the strata gave the following:

	Feet.	In.
1. Shale and yellow clay		10
2. Soft, yellow sandstone		10
3. Blue clay shale	2	
4. Keokuk beds not measured.		

Nos. 1, 2 and 3 of this section belong to the St. Louis group. South of this, along Ellison creek, thin outliers may exist, but none were recognized.

Keokuk Limestone.—This division of the lower Carboniferous series is found along the southern line of the county, at and near Dallas City. It rises to the north or northeast, and on going up the bluff road about a mile, it disappears, having either run out, or is so deeply covered by the Drift as not to be exposed along the streams.

East of Dallas City this limestone appears, forming the bluffs of Camp creek, but on going down the creek, northwest, it soon runs out, and the lower layers exposed are Burlington limestone. The Keokuk beds again appear in section 11, township 9, range 4. A section at this point is as follows:

	Feet.	In.
1. Soil and Drift (not measured).		
2. Yellow clay shale, containing a few geodes	1 to 2	
3. Limestone	3	2
4. Blue clay shale	?	

North of this it is again exposed on South Henderson creek. Its most westerly outcrop along this stream is about two miles east of Sagetown, in section 13, township 10, range 5. Here it appears at the top of the bluff, and a mile or two up the stream it forms the bed of the creek. Its most easterly exposure is about three miles southeast of Biggsville, in section 26, township 10, range 4. A short distance west of Biggsville, in section 17, the rocks exposed in the creek bluff gave the following section:

	Feet.	In.
1. Soil and Drift (not measured).		
2. Sandstone, soft	1	5
3. Yellow clay shale	1	7
4. Bluish clay shale	6	6
5. Limestone	4	6
6. Shale	2	2
7. Limestone	2	11
8. Clay		2
9. Shale		4
10. Limestone		5
11. Shale	1	1
12. Limestone		6
13. Shale	2	1
14. Limestone		11
15. Shale, with a little thin-bedded limestone	2	5
16. Argillaceous limestone	4	2
17. Limestone and a little shale	1	8
18. Shale		11
19. Limestone	3	
20. Shale		9
21. Limestone	1	
22. Thin-bedded limestone, with chert		5
23. Limestone, a little cherty	1	
24. Chert		4
25. Limestone	2	1
26. Shale, with thin layers of limestone		7
27. Limestone, very cherty, to the water		8
	43	7

All below No. 4 belongs to the Keokuk. The thickness of these strata are quite variable, but this section serves to give a general idea of their lithological character in this region. Some idea of their variableness may be had from the following section, made at Shoemaker's quarry, which is but a short distance from this point:

	Feet.	In.
1. St. Louis bed	3	8
2. Limestone	2	7
3. Shale	1	9
4. Limestone, very shaly		8
5. Limestone	2	11
6. Shale		7
7. Limestone	?	

Lower than this the quarry was not worked, and the rock was not exposed. This quarry lies near the top of the bluff, and corresponds very nearly with the upper part of the other section. North of the immediate vicinity of the South Henderson, this limestone is not exposed, and probably thins out rapidly in that direction, as the Burlington limestone appears but a few miles north of this, on South Smith creek.

Fossils.—The beds of this limestone that are found in this county, though not as rich in organic remains as at other localities, furnish some interesting specimens. They seem to have been deposited in a quiet ocean, where the beautiful crinoid and the delicate bryozoan abounded, and considerable portions of the limestone are thickly covered with the finely preserved skeletons of these organic forms. Indeed, these waters must have teemed with animal life, for not only the shales are full of their remains, but the solid limestone itself is largely composed of them. Numerous fish swam these seas in those early days, as the teeth and spines they have left, as a record, abundantly testify.

Among the fossils most common in this limestone, are the following: *Spirifer neglectus, S. Keokuk, S. lineatus, Hemipronites crenistria, Productus Wortheni, P. punctatus, Zaphrentis Dalii,* and an undiscribed *Chætetes.* Of the crinoidea most worthy of mention, is the *Barycrinus magnificus.* Nearly all the plates of a full grown individual, together with a portion of the arms and stem, I obtained near Biggsville. It is supposed to be the largest crinoid yet found in this State.

Burlington Limestone.—This formation, which underlies the Keokuk limestone, outcrops near Dallas City, in section 26, township 8, range 7, along the river bank. The quarries lie but little above the river, and are overflowed at high water. Higher up in the bluff, the Keokuk beds appear. Proceeding along the bluff road, there is an outcrop of the Burlington beds near the dividing line between sections 28 and 29, township 8, range 6. Northeast of this, in sections 22 and 23, the rock again appears, and is quarried. South and east of here, there are exposures of the rock in sections 24, 25 and 26; also in sections 29 and 30, of township 8, range 5, along Dugout

creek and its tributaries. Numbers of the more common crinoids were found at these localities. The rock here is considerably cherty, and much of it is thin-bedded. The thin layers, when freed from chert, furnish good material for lime, and at most of the openings there are one or more layers, a foot or so thick, that afford good building stone.

Between Dugout and Honey creeks there are no outcrops in the bluff, but they commence along the latter stream, in section 12, township 8, range 6. Higher up the creek we find outcrops in abundance for six or eight miles. Quarries have been opened in sections 1, 4 and 18, township 8, range 5; also in section 6, township 8, range 4. The rock has been more extensively worked here than on Dugout creek, and the layers are generally thicker. Blocks of any desirable size, from one to two or three feet thick, may be had. Some of the layers are of a yellowish-brown color, others are tinged with blue, while others are nearly white, or of a light, creamy gray.

Much assistance was rendered me by Messrs. D. Edmonds, Jas. Peasley and M. Nolen, while examining this region.

North of this, there are no exposures in the bluffs for several miles. Along Ellison creek, the rock does not appear till we reach the east part of township 9, range 4, but it crops out in several places on some of its branches. It has been worked in sections 23 and 25, township 9, range 5; also in sections 9, 20, 21 and 29, township 9, range 4.

In the bluffs of North Ellison, section 13, and of main Ellison, section 24 of the latter township, there are extensive and valuable quarries. These have been worked for a long time, and have furnished an immense amount of stone, both for lime and for building. Most of the strata here are sufficiently thick for any ordinary use. Section 13 affords an excellent article of building stone, the most of which is light-colored. That from section 24 is largely of a yellowish or reddish-brown, but otherwise of good quality. Some of the layers are more or less arenaceous. The following section was made here:

	Feet.
1. Drift	10 to 30
2. Limestone, with some layers of sandstone too little exposed to be separately measured	24
3. Shales of the Kinderhook group	?

The quarries on these two sections furnish the principal supply of building stone to the surrounding region for some distance, especially to the south and east. At these localities, fossils are quite abundant, especially crinoids.

At this place there is a dip of from 2° to 3° to the north or northeast. This inclination carries the beds of the Burlington below the surface, and probably continues to a point near Biggsville, from whence they rise towards the north, thus forming a shallow synclinal. At Biggsville, some forty of more feet of the St. Louis and Keokuk group overlie the Burlington. The first outcrop of the Burlington to the north, that was observed, was a little north of the centre of section 32, township 11, range 4.

West of this, the first exposure of importance is along the Mississippi bluff, in section 15, township 10, range 5. A short distance east of Sagetown, on the Chicago and Burlington branch of the C., B. and Q. railroad, there are extensive quarries owned and worked by A. Wallbaum, Esq. Work was commenced here in 1861. The quarries lie along South Henderson creek, one on either side, and to each there is a side-track from the railroad. A section from the highest point in the openings to the level of the railroad track gave the following section:

		Feet.	In.
1.	Drift	20 to 25	
2.	Chert and clay in irregular layers	10	4
3.	Limestone and chert in thin layers	21	10
4.	Limestone, mostly good, but in places a little cherty	18	10
5.	Soft sandstone	9	
6.	Chert		8

Some of the lower layers of the heavy limestone beds furnish a beautiful stone of a light-brown or yellowish tint that dresses well. This is largely used for window-caps, sills, etc. Large quantities of rock are sent from here by railroad into Warren, Knox and Peoria counties. The material for the second-class masonry of the Burlington railroad bridge, crossing the Mississippi, was from these quarries; the rest of the material coming from Joliet.

Northeast of Sagetown, in section 10, there are outcrops which furnish considerable quantities of stone, both for lime and building purposes. Further up the bluff, and along the Henderson river, the rock has been worked in section 2, of the same township; also, sections 35, 25 and 24, township 11, range 5. In section 25, at Mr. Bosler's quarry, I obtained the following section:

		Feet.	In.
1.	Slope, with outcrops of limestone	?	
2.	Limestone	3	
3.	Sandstone and chert	1	3
4.	Limestone	6	4
5.	Arenaceous limestone		4
6.	Limestone		10
7.	Shaly limestone and sandstone, with chert	6	3
8.	Calcareous sandstone, with chert	1	3

		Feet.	In.
9.	Shaly limestone		6
10.	Chert		6
11.	Limestone		8
12.	Chert and shaly limestone	8	2
13.	Limestone		6
14.	Shaly limestone and sandstone, with chert	3	
15.	Limestone	1	6
16.	Chert		11
17.	Slope, with outcrop of limestone	15	

In the northeast quarter of section 25 are extensive outcrops. At this point, on the farm of Mr. Jenks, there is a crevice in the rocks known as Jenk's cave. A portion of it has been destroyed in quarrying the rock, but for ten or fifteen feet from the entrance it is from six to nine feet high, when it suddenly becomes smaller. It has been penetrated about seventy-five feet.

Along north Smith creek the beds of the Burlington limestone form extensive ledges. Some of the lower and softer layers having been worn away by the combined action of the atmosphere and the water, the upper layers are frequently left projecting, in some cases quite a number of feet. Quarries have been opened in these ledges, at convenient points, in sections 19, 20 and 21, township 11, range 4. Considerable of the rock at these quarries has a yellow or reddish-brown color, other portions are light-colored, and make a very pretty building material. In section 19, on the north side of the creek, where the Drift had been removed so as to expose the upper surface of the rocks, they presented that peculiar ground and striated appearance commonly referred to the action of glaciers.

North of this there are no outcrops till we reach the southwest quarter of section 8. In section 5, on the Malay and Russ branches, the rock again appears. The most extensive quarry in this section is in the southwest quarter, on the farm of Mr. Malay. An abundant supply of good building material can be had here.

Along Fall creek there are exposures for two or three miles from its mouth. The rock has been most extensively worked in the north part of section 4. It is light-colored and compact. In township 12, range 4, sections 27 and 28, there are other outcrops of these beds. The strata as exposed here, commencing below the Drift, gave—

		Feet.
1.	Thin-bedded sandstone	2
2.	Limestone, containing thin beds of clay, and towards the top some chert	12

Some of the less common crinoids are comparatively abundant at this locality, and the rock here is mostly thick-bedded, light-colored, and, when free from chert, it makes good lime.

The most northerly exposure of the Burlington is in section 18, on the west and northwest sides of Bald bluff. Only about twenty feet are to be seen at this point, and the whole mass is thin-bedded, seldom over a foot in thickness, and is composed of brown arenaceous limestone and sandstone. Bald bluff is a little over two hundred feet high. From here the bluff runs back for several miles in nearly an easterly direction. The Burlington limestone, though not exposed north of here, may exist in the bluffs for some distance, where it probably thins out.

Fossils.—The beds of this limestone exposed in Henderson county probably belong, for the most part, to the upper Burlington division of the group; for at nearly every outcrop I obtained more or less crinoids, all of which have been identified as belonging to the upper Burlington. These beds are exceedingly rich in fossils, particularly crinoidea. Along the northern shores of the lower Carboniferous ocean these "stone lilies" flourished in much greater profusion than in any other known region; and nowhere else have their remains been found in such abundance, or so finely preserved, as in this rock. Though but part of the beds are found in this county, many species have been already obtained, and new ones are still being found. Other fossils, though not as numerous, are abundant, particularly brachiopods. Bryozoa are also found here, but not as abundantly as in the Keokuk rocks. Teeth and spines of fish are not uncommon.

Among the crinoids found are *Actinocrinus multiradiatus, A. Asterius, Batocrinus rotundus, B. oblatus, B. Christyi, B. æquibrachiatus, B. pyriformis, B. Verneuilianus, B. Nashvillæ, B. Koninckí, B. Hageri, Strotocrinus ægilops, S. liratus, S. umbrosus, S. subventricosus, S. glyptus, Dorycrinus cornigerus, D. dicornis, Steganocrinus pentagonus, Platycrinus plenus, Zeacrinus,* species nearly allied to *Z. elegans, Codaster stelliformis, Granatocrinus Norwoodi, G. Sayi* and *Pentremites elongatus.* In addition to these the following species of brachiopods were obtained: *Spirifer plenus, S. Grimesi, Productus Burlingtonensis, Chonetes Illinoiensis, Orthis Swallovi, O. Michelini,* and other genera, *Platyceras, Metopcoma umbella, Exactinopora sexradiata* and *Hadrophyllum glans.* This is not a complete list of the fossils of this group found in this county, but comprises the most common forms.

Kinderhook Group.—This group, which underlies the Burlington limestone, is exposed in but few places in Henderson county. Across the river, at Burlington, the beds of the group comprise variable strata of shales, gritstones and oolitic limestone. On this side, the

oolitic limestone and gritstone beds are wanting, and the group is represented by shales only, which are commonly argillaceous, though occasionally calcareous or arenaceous. The shale is usually in very thin layers, and of little or no value. There is a partial exposure of these beds in section 24, township 9, range 4, along Ellison creek, which gives the following succession, commencing below the Drift:

	Feet.
Burlington limestone	24
Shales of Kinderhook, to the surface of the stream	22

These beds outcrop for some distance along the Mississippi bluffs, but are mostly hidden by the talus of the sloping hills. A short distance southeast of Sagetown a boring was made a few years since for the purpose of obtaining water for a distillery. I am indebted to 'Squire Rice, of Sagetown, who had the work done, for the following section:

	Feet.	In.
1. Chert and clay	40	
2. Bluish clay shale	120	
3. Black slate		7
4. Bluish clay shale	162	
	322	7

Considerable of the shale was calcareous, but did not at any point become limestone. At a depth of three hundred and twenty-two feet the character of the rock had not changed, and the work was abandoned for the time, without having obtained water. This work was commenced in the Drift, at or near the base of the Burlington limestone.

Southeast of Oquawka these shales are exposed on Mr. Bosler's farm, at a little run, about twenty feet above the bed of Henderson river. Along South Smith creek, section 24, township 11, range 5, fifteen feet of these beds may be seen between the Burlington limestone and the creek bottom. At this locality there is a band of calcareous clay shale, from six to ten inches thick, just below the limestone. These shales, where exposed, seem to be destitute of fossils, none having been found after a close examination.

Economical Geology.

Building Stone.—Henderson county has an abundant, though not evenly distributed, supply of building stone. The Burlington limestone, which outcrops nearly from one end of the county to the other, along the bluffs of the Mississippi, and also on the larger

streams, will afford much the greater part of this supply. The rock is principally a light-colored, massive crinoidal limestone, which is but little affected by the weather. The prevailing color is a light bluish or yellowish-gray. In some localities a portion of the strata contains considerable oxide of iron, which gives the stone a much darker brownish color. It is tolerably even-bedded, in strata from six inches to two feet or more in thickness, and can be easily and cheaply quarried. A few good farm-houses have already been built in this county from this limestone, and, as wealth increases, it will probably come into more general use as a building stone.

The Burlington beds have been most extensively worked in the eastern part of the county, especially on Ellison creek and its branches, and near Sagetown. Of the quarries near the latter place the most important are those of A. Wallbaum, Esq. These have been opened about eight years, and at present are extensively worked, a large number of hands being employed. Many of the culverts and the abutments of the bridges of the Chicago, Burlington and Quincy Railroad are built of material obtained here. Large quantities of rock are now quarried here, and sent out of the county by this railroad.

The Keokuk limestone furnishes the balance of the building stone for this county. It is generally even-textured, dresses well, and affords strata sufficiently thick for all ordinary purposes for which building stone is required. It is exposed in the southwest part of the county, where it has been worked to some extent, but the strata rise to the north and soon run out, and are not again visible till north of Ellison creek, in township 9, range 4. Its greatest exposure is at and near Biggsville. Just west of town, in the bluffs of the South Henderson, there is a partial exposure of these beds of from twenty-five to thirty feet in thickness, a section of which has already been given.

Limestone for Lime.—The largest supply, and the best material for the manufacture of quick-lime, is furnished by the limestone beds of the Burlington group. At nearly all the exposures, rock suitable for this purpose can be had. The light-colored layers are nearly a pure carbonate of lime. At some localities, the quality of the rock is much injured by the quantity of cherty nodules present, which have to be removed before it is burned. The beds of the Keokuk also furnish considerable material for this purpose, which, when carefully selected, make good lime. The supply of stone, both for building and for lime, is inexhaustible.

The cherty nodules, so common in both the Keokuk and Burlington beds, while worthless for other uses, make a most excellent material for macadamizing roads, and for this purpose, are much more valuable than the limestone.

Coal.—The supply of this useful mineral in this county, is very limited. It is confined to one thin seam, which has been found only in sections 23 and 26, township 9, range 4. But little coal has been mined at either opening, and what has been taken out is reported to be of inferior quality. It is quite likely that this seam may be found extending from here to the south line of the county, at least in places, but probably does not extend much to the westward, unless it be in the northern part of township 8, range 4. Under the most favorable circumstances, the amount that can be obtained from this seam in this county will be comparatively small, and the inhabitants will have to depend mostly upon more favored localities for their supplies of coal. Along the line of the railroad it may be obtained, at reasonable rates, from the coal region to the east.

Other Minerals.—Clay, for brick-making, may be obtained from the subsoil of the uplands, at convenient points, throughout the county.

Iron Ore.—The variety called limonite was noticed at several localities, but not in any sufficient quantities to be of any importance.

Sulphuret of zinc, or *Sphalerite*, is of frequent occurrence in the geodiferous or concretionary masses of the Keokuk limestone.

Crystals of calcite (carbonate of lime) are found in the different limestone beds lining small cavities.

Soil and Agricultural Products.—The prairie soil is a dark-colored loam, everywhere productive where properly drained and cultivated. It contains a large amount of humus, which has resulted from the growth and decay of animal and vegetable matter upon the surface for untold ages. The soil of the timber lands or "oak barrens," is a clay loam, frequently containing but a small percentage of humus, and partaking largely of the nature of the subsoil, which usually lies but a few inches below the surface. The timber found upon these lands is principally red, black and white oak, and shell-bark and bitternut hickory. Along the slopes, the soil is usually much richer and darker colored, except near the top, where it has been nearly or quite washed away, and the subsoil appears. There the timber is much more varied than on the ridges, and we find the common varieties of oak, hickory and elm, sugar and white maple, linden, wild cherry, black walnut, butternut, red-bud, and several

other kinds. Wild grapes are abundant, and would seem to indicate, from the luxuriance of their growth, that they had found a soil adapted to their wants. A few vineyards have been started along the bluffs and on the uplands, which appear to be doing well. The finest orchards in the county are found along these bluff lands, which are much better adapted to fruit growing than those of the prairie.

CHAPTER XXIX.

WARREN COUNTY.

Warren county contains fifteen townships, or five hundred and forty square miles, and is bounded on the north by Mercer, on the east by Knox and Fulton, on the south by McDonough, and on the west by Henderson counties. The fourth principal meridian passes along its eastern border, and it embraces townships 8, 9, 10, 11 and 12 north, of ranges 1, 2 and 3 west. It is intersected in the northern part, from east to west, by main Henderson and Cedar creeks. South of this, there is South Henderson creek, which rises in township 10, range 2, and runs nearly west; while to the east, Slug run rises in the northern part of township 10, range 1, and passing south, empties into Cedar Fork, near the eastern line of the county. Cedar Fork rises near the western boundary of township 9, range 2, and runs a little to the south of east; south of this is Nigger creek, of which Little Nigger and Swan creeks are branches. By these and a number of smaller streams the county is well watered and its surface thoroughly drained.

Springs are not very abundant, but there are some which are large and valuable. Good wells may usually be obtained at depths varying from ten to thirty feet, but if, at the latter depth, water is not obtained, it is generally necessary to dig sixty feet or more, or through the blue clay of the Drift.

The larger part of Warren county is prairie, but the prairies are seldom large, being divided by the numerous streams. The soil is a dark-colored vegetable loam, differing but little, in its general character and appearance, from that of the adjoining counties. Along the ridges that skirt the streams the soil is of less depth, lighter colored and less fertile. The subsoil is a yellow or brown clay.

Much of the land lying along the water courses was originally covered with timber. Large portions of this have been cut off, and the work is still continued. The varieties of timber found here are nearly the same as in Henderson county.

Surface Geology.

Two of the subdivisions of the Quaternary system, viz, the Alluvium and Drift, are found in this county. The Alluvial deposits are not extensive, being confined to the borders of the streams, and are seldom over half a mile in width, while commonly they are much less. The soil of these bottom lands is very fertile, and consists of black loam, more or less mixed with sand and gravel.

The Drift covers the whole surface of the uplands to a depth of from ten to eighty feet or more. These deposits comprise a series of yellow, brown and blue clays, locally intermingled with sand and gravel. In the northwestern part of the county the Drift rests upon the Kinderhook group and Burlington limestone, but elsewhere, as far as is known, upon the Coal Measures. Loose coal is frequently found in the Drift, but this is no indication that there is any bed of it in the immediate vicinity.

The older geological formations found in this county are the—

Coal Measures,
Burlington Limestone, and
Kinderhook Group.

The *Coal Measures* underlie nearly the whole of Warren county. Sumner and the northern part of Hale townships probably embraces the entire district, or nearly so, where they are not found. The Coal Measures comprise, in this county, various strata of shales, sandstones, limestones, clays and coal, and attain a thickness, in some parts, of from one to two hundred feet. These strata rest upon the Burlington limestone, and where this is found near the surface or reached in shafting, no coal need be looked for in deeper explorations. Thus far, the coal mines that have been discovered are, with but one exception, confined to the townships in ranges 1 and 2. There are three workable coal seams found in this county.

The upper seam is from three feet to three feet six inches in thickness, and has been found at but one locality—section 17, township 8, range 2. There is some doubt as to which seam this may be referred, as I was unable to make any measurement of the strata between it and the seam (No. 2) below, but the distance is probably not over forty or fifty feet between them, perhaps less. As the only

open bank in this seam was on fire when I was there, an examination could not be made, or any specimens of the coal obtained, but I have learned that the roof is black slate and the floor arenaceous shale. It may be coal No. 3 of the Illinois section, and the coal obtained from it is reported to be of good quality.

The next seam, No. 2 of the Illinois section, is from one foot eight inches to two feet thick in this county. Elsewhere it attains a thickness of from three to five feet. Though thinner, this seam is more extensively worked than either of the others. It is worked along Cedar creek, on section 19, township 11, range 1, and sections 13, 14, 23 and 24, township 11, range 2. Also, in the latter township, there are other mines along Honey run and its branches, in sections 25, 35 and 36. The strata were reported by the miners to be, in this neighborhood, as follows:

		Ft.	In		Ft.	In.
1.	Drift, not measured	..	..	..	..	..
2.	Clay shale (soapstone)	10	..	to	20	..
3.	Limestone	..	..		0	6
4.	Blue clay shale and black slate	2	..	to	2	6
5.	Coal, No. 2 of Illinois section	1	8	to	2	3
6.	Fire-clay	3	..	to	8	..
7.	Bituminous limestone	2	..	to	6	..
8.	Clay shale					?
9.	Thin coal					?

The coal is of good quality, and, though containing some pyrite (the "sulphur" of the miners), it is easily freed from it.

In sections 23 and 26, township 10, range 1, mines have been opened. We again find this seam worked in section 3, township 9, range 1. In this locality there is sometimes two or three inches of cannel coal at the top of the seam. South of this, in township 8, range 1, there are mines in sections 23 and 26. Though the coal here is but one foot, six inches thick, large amounts of superior coal are taken from these mines.

From the bluffs of Nigger creek, sections 14 and 23, the following section was obtained, which gives a general idea of how the strata lie in this region:

		Ft.	In.		Ft.	In.
1.	Clay shale				8	
2.	Coal, No. 2 of the Illinois section				1	6
3.	Fire clay				3	
4.	Clay shale				11	
5.	Coal and black slate					8
6.	Clay shale	1	6	to	2	6
7.	Sandstone				1	6
8.	Clay shale	20	2	to	22	
9.	Sandstones or arenaceous shale	3	9	to	7	
10.	Arenaceous shale	2	6	to	3	
11.	Clay shale				3	6
12.	Coal		4	to		10
13.	Sandstone	1	4	to	3	

		Ft.	In.		Ft.	In.
14.	Clay shale					4
15.	Slaty coal	1	6	to	1	9
16.	Sandstone or arenaceous shale	1	5	to	4	6
17.	Clay shale	1	4	to	2	
18.	Coal		6	to	1	0
19.	Fire clay				2	3
20.	Black slate				3	6
21.	Bituminous shale					4
22.	Fire clay				2	

In No 9 of this section, there are some valuable quarries. The rock is from six to seven feet thick at some localities, and the whole of it is thick bedded, so that blocks of any desirable size can be had. There are, however, large concretions of a calcareo-arenaceous rock, locally called "flint," in the sandstones. One of these was taken from the quarry of Mr. J. Worden, section 14, that was about two and one-half feet thick, six to seven wide, and from ten to twelve long. This rock is very compact, hard enough to scratch glass, and in chloro-hydric acid effervesces slightly. It is not considered of any value, and is so hard that when it occurs in large masses it is very expensive getting it out of the way. At other localities, this sandstone is replaced by arenaceous shale.

No. 13 of the section is locally called "water flint," and is easily recognized, whenever met with in this vicinity, by the numerous specimens of *Stigmaria ficoides* present in it. These have much the appearance of dark-brown or black roots, and in some cases the rock seems full of them. This rock is a somewhat argillaceous sandstone, compact, and not usually as hard as No. 9.

No. 15 may possibly be the representative of coal No. 1, but this seems doubtful.

In the northeast quarter of section 23, the strata appear to have been considerably disturbed, and at one place are tilted, for a short distance, to an angle of about 5°. Not far from here, two faults are to be seen within a few yards of each other.*

For some distance up the creek, northwest, the strata appear to have been somewhat disturbed, and dip in all directions. In sections 26 and 22, mines have been opened and more or less work done. In section 16, the following sections were obtained at points but a few rods apart:

		No. 1. Ft.	No. 1. In.	No. 2 Ft.	No. 2 In.
1.	Coal	?		1	6
2.	Fire clay		8		
3.	Coal		3		

*This appearance has probably been occasioned by the undermining of the strata in the erosion of the creek valley, and their subsequent displacement by being crushed downwards from the weight of the superincumbent beds. A. H. W.

		No. 1. Ft.	No. 1. In.	No. 2. Ft.	No. 2. In.
4.	Arenaceous shale	2			
5.	Light colored clay shale	1	8		8
6.	Dark-blue clay shale		4		11
7.	Sandstone		6	1	3
8.	Black slate	8			?
9.	Coal and black slate		3		

Several of the strata were readily traced from one point to the other, and this section will serve to illustrate how, in shafts only a short distance apart, the strata may vary considerably.

West of this point, in township 8, range 2, this seam crops out for some distance along Swan and Little Nigger creeks. At these localities mining has been carried on for years, and in some places the bluffs are almost honey-combed by the entries, new and old. The mines along Little Nigger creek are mostly in sections 7, 8, 9 and 10. In some of them the fire-clay below the coal is varied in color, the usual tints being a light-blue, though in some places it is nearly white, while in others it is yellow or yellow and red. It is said that on being burned the yellow turns to a blood red. Along Swan creek, the mines are in sections 15, 16 and 21. A little north of Roseville, in section 30, township 9, range 2, this seam has been worked to some extent.

The coals of this county are mostly worked by drifts or tunnels driven horizontally into the hill-sides along the outcrop of the seams, and owing to the shaly character of the roof of No. 2, considerable expense is incurred in "cribbing" to sustain the roof. The thickness of the coal is usually from twenty inches to two feet, and in driving the entries it becomes necessary to remove a portion of the roof shales, or the under-clay, in order to obtain the amount of vertical space required to take out the coal.

The lower seam, No. 1 of the Illinois section, varies from two to four feet in thickness in this county. It is generally overlaid by black slate, or a dark colored, and frequently shaly limestone. This forms a very good roof, and makes the working of this seam less expensive than that of the seam above, as, frequently, but little or no cribbing is required.

In section 14, township 12, range 2, this coal crops out along the bluffs. In the eastern part of the section, it is from three to three and a-half feet thick, and as it is here overlaid by clay, the upper part of the coal is left for a roof. That part that is left is however, of but little value, it being impure.

Flattened nodules of impure pyrite, called "nigger-heads" by the miners, and frequently a foot or so in diameter, are not uncommon

at some localities in the upper part of the seam. Many of these contain numbers of fossils, which are frequently well preserved. Some of the nodules from this mine afforded *Productus longispinus*, var. *muricatus*, *Athyris subtilita*, *Spirifer cameratus*, *Chonetes mesoloba*, *Spiriferina Kentuckensis*, *Hemipronites crenistria*, *Pinna* —? *Lima retifera*, *Schizodus curtus*, *Cardimorpha Missouriensis*, *Edmondia ovata*, *Streblopteria tenuilineata*, *Pleurophorus radiata*, *Allorisma subcuneata*, *A. costata*, *Bellerophon Montfortianus*, *Rhynchonella Eatoniæformis*, *Pleurotomaria Grayvillensis*, *P. sphærulata*, var. *depressa*, *Nautilus*, and some others not recognized.

Of these, the following species also occur in the upper Coal Measures: *Spirifer cameratus*, *Spiriferina Kentuckensis*, *Allorisma subcuneata*, *Athyris subtilita*, *Edmondia ovata*, *Lima retifera*, *Schizodu curtus*, *Pleurotomaria Grayvillensis*, *Bellerophon Montfortianus*.

A little west of this point, and in the same section, the roof is black slate, a few inches thick, and is overlaid with limestone. Here the coal is but about three feet thick. In the western part of this section the seam is from three and a half to four feet thick, with a roof similar to the last. Did not learn the thickness of the limestone, but, judging from the exposures in some old quarries, it must be several feet. At these mines sandstone underlies the coal. Besides these there are other mines in this township, in sections 15, 22 and 23.

In township 12, range 1, there are a number of mines which probably belong to this seam. The exposures in sections 21, 22 and 27 showed 1 foot 6 inches of coal overlaid by 2 feet of soft clay shale.

There are also mines in sections 29, 30 and 32. As these are worked only during cold weather, I was able to make but little examination of them, as I visited this neighborhood in the summer. In township 12, range 2, the only mines in this seam are in sections 10 and 15. I am indebted to Mr. Chicken for the following section of the strata penetrated by his shaft:

		Feet.	In.
1.	Soil and clay, about	4	
2.	Sandstone	5	
3.	Light-colored clay shale	4	
4.	Dark-blue clay shale	4	
5.	Compact calcareous clay shale	1	6
6.	Chert	1	6
7.	Clay		2
8.	Dark-colored limestone	6 in. to	2
9.	Coal, average	2	8

In section 4, township 9, range 3, the coal is reported to be two feet two inches thick. As it lies below the bed of the stream, it is

worked by means of a shaft. A shaly limestone lies but little above the coal, but I was unable to learn whether there is any slate between them. This mine is just south of the road on the township line, and on the other side of the road this limestone has been quarried. Here I obtained *Productus longispinus, P. semireticulatus, Aviculopecten, Naticopsis,* and some other fossils.

In township 9, range 1, on the southwest quarter of section 24, this seam crops out in the bluffs of Slug run, on the Peabody farm. The coal is about three feet thick, and overlaid by a dark, bluish limestone. About ten feet below this seam there is an outcrop of the Burlington limestone, but the intervening strata were not exposed. In section 26, along Cedar Fork, this coal is exposed a little above the bed of the creek. A section of the strata gave:

		Feet.
1.	Bluish-black limestone	8 to 10
2.	Black slate	6 in. to 2
3.	Coal	3

A short distance up the stream there appears to be a fault, and apparently higher strata are exposed, and show the following succession:

		Feet.	In.
1.	Clay shale	not measured	
2.	Sandstone, about	14	
3.	Coal	1	1
4.	Fire-clay, passing into clay shales	2	
5.	Black slate	not measured	

The strata on either side can be traced to within a few feet of the fault. This, however, is not exposed, but a small gulch runs down the bluff at a point where it probably exists.

In section 13, township 8, range 1, there is another outcrop along Nigger creek, which probably belongs to this seam. The exposed strata give the following section:

		Feet.	In.
1.	Clay shale	not measured	
2.	Coal		10
3.	Shale, with a band of sandstone about 14 feet from the top	22	
4.	Sandstone	1	6
5.	Black slate	1	6
6.	Coal, with some slate and clay shale	2 ft. 6 in. to	3
7.	Sandstone and arenaceous shale	3	4
8.	Coal	from 1 in. to	2
9.	Fire-clay	1	
10.	Sandstone	not measured	

The mines at this place have been abandoned for some time. The coal was reported to be of poor quality, and mixed with slate.

It is probable that everywhere in this county this seam lies but a few feet from the bottom of the Coal Measures, and wherever the lower strata are exposed they rest upon the Burlington limestone. North-

west of Monmouth, in section 7, township 11, range 2, the rocks exposed in the bluffs of Cedar creek gave the following section:

		Feet.
1.	Slope, containing black slate, fire-clay and coal	not measured.
2.	Sandstone, with thin beds of shale	10
3.	Burlington limestone, as far as exposed	33

The coal mentioned in No. 1 of this section is not likely to prove valuable, as it lies too near the surface.

At or near Monmouth a boring was made, but I was unable to obtain a copy of the journal of the work, though it was promised me. As nearly as I could learn, only about ten inches of rotten coal was found. It is probable that it will be necessary to go farther east or south to find any place where the seam will prove workable.*

It is doubtful whether the lower seam can be found underlying No. 2 throughout the county, but still it may, and probably does, exist all along the eastern border. At the outcrop in Henderson county, a few miles southwest of Ellison, coal No. 2 lies but a short distance above the lower formations, and the same may prove to be the case along the southwestern portion of this county. Still, a seam which is probably No. 1 is found but a short distance northeast of Ellison. In searching for coal, either by shaft or otherwise, it should always be borne in mind that, when any of the beds of lower Carboniferous limestone are reached, it is useless to go deeper in search of it.

Burlington Limestone.—The beds of this group immediately underlie the Coal Measures in this county, wherever the junction of the coal with the underlying beds can be seen. In the south part of the county there may be thin beds of the St. Louis between them, and east of Biggsville, and near Young America, the Keokuk may be present, but there are no outcrops where either can be seen beneath the Coal Measures.

The Burlington group, in Warren county, consists mainly of light-gray and brown limestones, with some layers of sandstone, chert and calcareous clay shale, and attains a thickness of from forty to fifty feet. These beds outcrop along the small streams in the southern part of township 12, range 3. Section 31 furnishes layers of good building material sufficiently thick for all ordinary purposes.

---

* Since this report was made, Dr. A. W. Black, of Monmouth, has sunk a shaft to the coal which was found at the depth of about forty feet below the surface. The shaft is a little east of the city, and the coal found to be from twenty-four to thirty inches in thickness, and of excellent quality. This is probably coal No. 2 of the Fulton county section.

A. H. W.

In sections 32 and 33 it is thin-bedded where it has been worked. In section 35, at Rockwell's mill, on Cedar creek, the rock is quite arenaceous. When the quarries were first opened they afforded good limestone, but on working into the bluff the beds are changed to a soft or rotten sandstone. This exposure of the strata gave the following section:

	Feet.	In.
1. Limestone and sandstone	15	6
2. Sandstone	17	
3. Green argillaceous sand		1
4. Shale of Kinderhook to the bed of the creek	17	

East of this, in sections 19, 20, 29 and 30, township 12, range 2, the Burlington limestone outcrops along some of the small streams, and is overlaid by some thin strata of the Coal Measures. As far as exposed here, it is somewhat arenaceous, with much chert. This is the most northerly outcrop of the group in this county, and in Henderson county it is exposed but a very little further north. Thin outliers may be found for some distance in this direction, beneath the Coal Measures, but, like the other members of the lower Carboniferous series, it soon thins out.

In section 1, township 11, range 3, there are extensive quarries in this limestone. Some of the layers are very light-colored and even textured, and are reported to take a good polish. Other layers, though not as light-colored, furnish a durable building material. Much lime is burned here, and the rock being nearly a pure carbonate of lime, affords a good article. In section 2 and the northwest quarter of 11, there are small outcrops. In sections 4, 5, and the north part of 8, there are exposures all along some small streams. The one in section 4 gave the following succession of strata:

	Feet.	In.
1. Chert	2	
2. Thin-bedded sandstone, with a little chert	7	
3. Limestone and chert	1	9
4. Limestone	9	6
5. Slope to the water, with outcrop of limestone	5	6

Much material, both for building and making lime, has been taken from these places. As we go south, from the north line of the township, we find thin outliers of the Coal Measures forming the tops of the bluffs, till in section 8 the Burlington beds disappear beneath the sandstone and conglomerate, which form the base of the Coal Measures.

On Cedar creek, from Rockwell's mill, in township 12, range 3, to Olmstead's mill, in township 11, range 2, this limestone outcrops almost continuously along the bluffs, frequently in perpendicular or

overhanging ledges. Occasionally it is covered by the sloping talus of the hills, but only to be again exposed a little further on. In section 7 of the latter township, it is overlaid by a few feet of the Coal Measures, and at this point gave the following section:

	Feet.	In.
1. Slope, with outcrops of Coal Measure strata not measured.		
2. Slope, with outcrops of Burlington limestone	7	6
3. Limestone and chert	3	2
4. Compact calcareous clay shale	2	
5. Limestone	11	6
6. Sandstone and limestone, to the bed of the creek	8	6

Near the middle of section 7, on Cedar creek, and along a little branch putting in from the southeast, there are extensive quarries in the bluffs, which supply Monmouth and the adjoining region with large quantities of excellent building material. As we proceed up the creek, the outcrops, though still large, are not as extensive as below, being more frequently covered by the talus of the bluffs. In the east part of section 7, they are overlaid by heavy beds of Coal Measure sandstone. Small quarries have been opened at various points from here to the east half of section 8, where, a few rods south of the Cedar, and along some small runs that put into it, there are extensive quarries. The rock obtained here is mostly taken to Monmouth and its vicinity. At this place, and for some distance up the creek, the bluffs are not so high as farther down, and the Coal Measure strata have been largely, and in some places entirely removed. From here to the middle of section 9, though occasionally outcropping, the rock has been but litte worked. At this point there is a small quarry on a run coming in from the northeast. Near this, along a branch entering the Cedar from the south, the rock has been almost continuously worked, from near the mouth of the stream to the centre of section 16. In the southeast quarter of section 9, the Burlington limestone disappears beneath the strata of the Coal Measures, and does not again appear to the eastward along Cedar creek.

In section 24, township 9, range 1, the strata dip to the north of west and south of east, forming an anticlinal. As only a few feet of the beds were exposed, I was unable to determine, accurately, the direction of the dip and the trend of the anticlinal. To the eastward, the Coal Measures thicken, and it is not probable that the limestone is again exposed.

The limestones of this group are generally rich in fossil remains, which are well preserved, and the rock is largely composed, in most cases, of the fragments of crinoidea, and at almost every point where it is exposed, more or less good fossils may be obtained.

Among the Brachiopods found here, were *Spirifer Grimesi*, *S. plenus*, *Productus semireticulatus*, var. *Burlingtonensis*, *Orthis Michelini* and *O. Swallovi*.

The crinoidea are not as common as farther west, but some fine ones were obtained here, among which were *Actinocrinus rotundus*, *A. oblatus*, *Batocrinus Verneuilianus*, *B. Christyi*, *B. Koninckı*, *B. pyriformis*, *Agaricocrinus*, *Granatocrinus Norwoodi*, and *Pentremites elongatus*.

Kinderhook Group.—The beds of this group, which underlie the Burlington limestone, are, as far as exposed in this county, composed of shale, with occasional layers that are more or less calcareous or arenaceous, and compact. Some of the more compact portions might be used for building purposes, where not exposed to the weather; but an abundance of far superior building stone renders this unnecessary. It seems probable that but a few feet of the upper portions of the group are exposed at the different outcrops, but being apparently destitute of fossils, it is difficult to recognize the beds. At Rockwell's mill, section 35, township 12, range 3, there is an exposure which gives this section:

	Feet.	In.
1. Burlington limestone	32	6
2. Compact, calcareous clay shale	from 6 inches to 1	0
3. Blue clay shale, to the level of the creek	16	0

In the south part of section 15 there is another outcrop of a few feet along a small branch, and in section 9 there is an exposure of shale which probably belongs to the Kinderhook. At this point one or two shafts have been sunk, for a short distance, in search of coal. It is reported that the water came in so fast that the work was suspended, without, of course, having found any indications of coal.

North of here the beds of this group are not exposed, but may extend for some distance in that direction beneath the Coal Measures; but, like the other members of the lower Carboniferous series, this group also soon thins out. There were no fossils found in these beds at any point in the county.

As these shales very closely resemble those of the Coal Measures, those unacquainted with geology will be very likely to mistake them for the latter. This has been done at nearly every exposure, though, as far as I learned, but little time had been spent in examinations. Notwithstanding all that experienced coal miners may say to the contrary, it is useless to search for coal in the shales of the Kinderhook group.

Economical Geology.

Coal.—The supply of this valuable mineral is mostly obtained from seams Nos. 1 and 2, the upper bed, No. 3, affording but a small amount.

Coal No. 2, though thinner at most places than No. 1, is more extensively worked, as it is generally more easily got at, and affords an excellent quality of coal. This seam has been worked principally in townships 8, 9 and 11, ranges 1 and 2. At most of the mines there is more or less sulphuret of iron mixed with the coal, which has to be separated from it before sending it to market.

The lower seam is, at nearly all localities, considerably thicker than No. 2, and hence the yield is much greater. This coal, though generally of fair quality, is not as good as that from the bed above. It has been worked principally in township 9, range 1, township 11, range 2, and township 12, ranges 1 and 2. It probably underlies the whole of township 9, of range 1, and a considerable portion of each township in range 2, and, perhaps, a portion of townships 8, 9 and 10 of range 3. At a single place in range 3, along the dividing line between townships 9 and 10, coal, apparently belonging to this seam, has been found, and a mine opened. The coal is but twenty-six inches thick at this point.

Building Stone.—The Burlington limestone furnishes a good article of building stone, and is found along the southern part of township 12, range 3, and the northern part of township 11, range 3; also, in the northwest part of township 11, range 2. From Rockwell's mill for several miles up Cedar creek, the outcrops of these beds form mural or overhanging bluffs, from thirty to forty feet high. Notwithstanding the immense quantities of stone taken from this region, these vast ledges appear to have been but slightly worked at a few points. These outcrops are not on Cedar creek alone, but along all the branches that enter it in this vicinity. Nearly all the rock is light-colored, some portions of it being tinged with a light shade of buff, and others with blue. It is compact and dresses well, and some of the layers afford a stone susceptible of taking a good polish.

The sandstones of the Coal Measures afford a valuable building rock, and the most extensive quarries are in Greenbush and Berwick townships. The most important quarries in Greenbush, township 8, range 1, are located along Nigger creek, in sections 14 and 15.

The following section will show the thickness and relative position of the beds:

		Feet.	In.
1.	Coal (No. 2 of the Illinois section)	1	6
2.	Fire-clay	3	0
3.	Clay shale	11	0
4.	Coal and black slate		8
5.	Clay shale, from 1 ft. 6 in. to	2	6
6.	Sandstone	1	6
7.	Clay shale, from 20 ft. 2 in. to	22	0
8.	Sandstone or shale, from 3 ft. 9 in. to	7	

The quarries are in No. 8 of this section, and the rock is from five to seven feet thick where worked.

The most important quarries in Berwick, township 9, range 1, are in sections 14 and 15, along Slug run, and in sections 18 and 20, on Cedar fork. The sandstone is much thicker here than in Greenbush, it being from twelve to fourteen feet thick, and in some places more. I was unable to ascertain the position of the strata in which these quarries are, but it may be the same as No. 8 of the last section.

In section 11 the sandstone forms immense ledges, which in some places overhang the water ten and fifteen feet. "Rock House," as it is called, is in this section, and was formed in some past time, when the bed of the stream was considerably higher than at present, by the water cutting a passage through a portion of the lower strata. In the denuding process a large pillar of sandstone was left, and now supports the outer edge of the upper strata, which forms the roof.

In some localities along Slug run this sandstone is of little value, as it crumbles to pieces by exposure to the weather. The quarry stone is quite soft, splits readily and dresses easily, and may be obtained in large blocks. In some of the quarries there is a bluish calcareo-arenaceous rock, hard and tough, that occurs in concretions. This makes a very durable building stone, but is hard to work.

In section 8, township 11, range 3, there is a somewhat extensive quarry in the sandstone below coal No. 1, and very near the bottom of the Coal Measures. A similar rock was formerly worked in sections 7 and 8, township 11, range 2, along Cedar creek. Besides those already mentioned, there are some smaller quarries in township 9, range 3, township 10, range 1, and township 12, ranges 1 and 2.

Limestone for Lime.—Nearly all the outcrops of the Burlington will afford abundant supplies of material for this purpose, and being a nearly pure carbonate of lime, it yields an excellent article. Some of the Coal Measure limestone has been burned, but the supply from

this source is very limited. Lime is, at present, most extensively manufactured in section 1, township 11, range 3. Better facilities for getting fuel for the kilns, and the manufactured lime to market, is all that is necessary to render this business an important source of wealth to some portions of the county.

CHAPTER XXX.

MERCER COUNTY.

Mercer county lies on the northwestern border of the State, and embraces a little more than fifteen townships, or about five hundred and fifty square miles. It is bounded on the north by Rock Island county; on the east, by Henry and Knox; on the south, by Warren and Henderson; and on the west, by the Mississippi river. The fourth principal meridian passes along its eastern border, and it embraces townships 13, 14 and 15 north, of ranges 1, 2, 3, 4 and a part of 5 and 6 west.

It is intersected from east to west, through the northern portion, by Edwards river, which, near the western border, changes its course, and running in a southwesterly direction, empties into the Mississippi about a mile and a half below New Boston. A few miles south of the Edwards is Pope creek, which passes through the county in the same direction, and enters the Mississippi at Keithsburg. In addition to these, there are in the northwest, Eliza creek, which empties into Swan lake, and Camp creek, a tributary of the Edwards; while in the northeast are Parker's run and another Camp creek, also branches of the Edwards. South of these is North Pope, a tributary of Pope creek, and in the southeast are North Henderson and Duck creeks. These, together with some smaller streams, furnish an abundant supply of water.

A large portion of this county is prairie, while along the borders of the streams are the so-called "barrens." The soil of the prairie is usually a deep black or chocolate-colored loam, with a yellow or dark-brown clay subsoil. The soil of the barrens is similar to that of the prairie, only lighter-colored and of less depth, while along the upper part of the slope it is of a light-brown or yellowish color, owing to the character of the subsoil, which comes near the surface.

In some portions of the barrens there is but a thin covering of soil, and in these places it is quite light-colored, showing that but little humus is present.

Surface Geology.

The surface deposits of this county comprises the usual sub-divisions of the Quaternary, Alluvium, Loess and Drift. The most extensive alluvial deposit is that of the Mississippi bottom. This extends along the whole western border of the county, with a varied width of from two to five miles. Of this, that portion which is situated in the northwest, and extends as far south as New Boston, is much cut up by swamps, lakes and bays. Much of this land is comparatively low, and valuable chiefly for meadow and grazing.

Through a large portion of these bottom lands there are one or more low ridges of sand. The soil of this sandy portion is of but little value, there being but few seasons when it is wet enough to produce full crops. In other portions, the soil is a deep black loam and very productive. Narrow alluvial belts are also found along nearly all the water courses, the soil of which is very dark-colored, but more or less intermingled with sand and pebbles.

Loess.—This deposit is found capping the Mississippi bluffs, and attains a variable thickness of from ten to forty feet. It is a calcareous marl of light-brown or buff color, and generally contains great numbers of bleached fresh-water shells, mostly of species existing in the streams of the adjoining region.

Drift.—The deposits of this sub-division comprise a series of brown and blue clays, locally intermingled with sand, gravel and small pebbles, which are spread over the entire surface of the uplands, and underlying the Loess, where both are present. Some large boulders of igneous or metamorphic rocks lie scattered in the valleys of the water-courses, but they are not numerous. In section 9, township 13, range 4, and forming a portion of the bluff of Pope creek, there are heavy beds of a sandy marl, containing some recent shells. Two genera were recognized among the specimens obtained here, *Lymnea* and *Succinea*. Some fifteen or twenty feet of these beds were exposed, and they appear to underlie the yellow clays of the Drift, which form the subsoil.*

*It is probable the beds of sandy marl here referred to are equivalent to the Post Tertiary beds of stratified sands, clay, etc., mentioned in the preceding chapters as occurring in McLean, Tazewell, Adams, and some other counties, and though underlying, and consequently older than the Drift, they have as yet afforded no fossil molluscs of extinct species.

A. H. W.

The older geological formations exposed in this county, belong to the Coal Measures and the Kinderhook group.

Coal Measures.—Nearly all the stratified rocks exposed in this county belong to the Coal Measures, and include the lower portion from coal No. 3 (?) of the Illinois section, to near the base of this formation. They comprise various strata of limestone, sandstone, clay shale and coal, and attain a thickness of from one hundred to one hundred and fifty, or possibly, in some places, two hundred feet. There are three, perhaps four, seams of coal worked in this county.

The upper seam, No. 3 (?) of the Illinois section, has been found and worked at but one point, sections 31 and 32, township 14, range 2. This seam is from three to five feet thick, and the coal of good quality. From Mr. Martin's shaft, in the southwest quarter of section 32, and the exposed rocks in the bluff below, the following section was obtained:

		Feet.	In.
1.	Drift	not measured	
2.	White clay; sometimes sandy	7	
3.	Limestone, impure	18	
4.	Coal No. 3 (?)	3 to 5	
5.	Sandstone, or sandy shale	10 to 15	
6.	Slate, not always present	2	
7.	Limestone		8
8.	Coal	1 foot 10 inches to 2	6
9.	Clay	4	
10.	Slate, penetrated	16	

The limestone over the coal No. 4 of this section contains numerous fossils, among which are *Hemipronites crenistria, Lima retifera, Productus Nebrascensis, Conularia,* and several species of *Bryozoa.*

The second coal seam, No. 2 of the Illinois section, is, in this county, from one and a half to two and a half feet thick. This seam has been found in quite a number of places, but is at present worked at but two or three points. In sections 20 and 21, township 13, range 2, it has been extensively mined, though but one mine, in section 20, is now in operation. The exposed strata in this vicinity give the following section:

		Feet.	In.
1.	Coal, No. 3 (?)	a trace	
2.	Sandstone, or sandy clay, about	15	
3.	Limestone, impure and shaly	1 foot 2 inches to 1	4
4.	Blue arenaceous clay shale, 6 inches to	1	
5.	Coal, No. 2	2 feet to 2	6
6.	Blue clay	but partially exposed	

The sandstone, No. 2 of this section, is light-colored and soft, but hardens on exposure. The quarries that are and may be opened at or near this locality, will furnish an abundant supply of a fair article

of building stone for the supply of the adjacent region. About two miles down North Henderson creek, in the southwest quarter of section 19, there is an extensive quarry of sandstone and conglomerate. This probably lies below coal No. 2, and near the base of the Coal Measures. The sandstone is of fair quality, and can be had in blocks of any desirable size, and, when first taken out, is soft and easily worked, but hardens by exposure. The conglomerate, though of little value to the builder, is interesting to the geologist, on account of its containing a considerable amount of the cherts of the Burlington limestone. These are almost entirely composed of crinoid stems and heads, with a few other fossils. As is commonly the case in these cherts, the fossils are not often well preserved, and of those obtained, but few could be recognized, among which were *Batocrinus oblatus*, *Actinocrinus*, *Platycrinus* and *Spirifer imbrex*.

In section 32, township 14, range 2, the coal seam No. 2 was formerly worked, but the thicker seam above having been discovered this one was abandoned. In section 33, township 14, range 3, a mine was opened a few years since, but the amount of pyrites contained in the coal was so great that it could not be profitably worked in competition with the better coals. Near Aledo, in section 20, several banks have been opened, at one of which the following section was obtained:

		Feet.	In.
1.	Clay shale	not measured.	
2.	Limestone	1 to 1	6
3.	Clay, passing into clay shale	3 to	4
4.	Coal No. 2	1 foot 6 inches to	2
5.	Clay	not measured.	

No. 2 of this section, and the lower portion of the shale above it, contains a number of fossils, among which are *Spirifer lineatus*, *Athyris subtilita*, *Pleurophorus soleniformis*, *Productus*, etc. In section 8, a little north of Aledo, a mine was opened, though worked but little, in which the strata presented a peculiar feature, as will be seen from the following section:

		Feet.	In.
1.	Shale	not measured.	
2.	Sandstone	8 to 9	
3.	Clay shale	1 to 3	
4.	Coal		8
5.	Limestone		6
6.	Coal	1	6
7.	Clay	not measured.	

This is the only instance in which I have noticed a stratum of limestone separating the coal.

In section 9 there are extensive quarries in the sandstone, No. 2 of the last section. They have been worked for years, and have furnished immense amounts of good building material.

Near Millersburg, section 2, township 14, range 4, there is a mine that is worked where the coal is from two to two and a half feet thick.

Section 1 affords a sandstone which is much harder than that obtained from most of the other quarries. There is but a single layer found here, and this is only from a foot and a half to two feet thick. I was unable to learn its position, as but little of the strata above or below was exposed. The material for the foundation of the jail at Aledo was taken from this locality.

A little coal has been mined in sections 35 and 36, township 15, range 3. The exposed strata here gave:

		Feet.	In.
1.	Clay shale	not measured.	
2.	Sandstone, about	15	
3.	Blue clay or clay shale	2 to 3	
4.	Coal	1 foot 6 inches to 2	
5.	Clay	not measured.	

There are extensive quarries in the sandstone, No. 2 of this section, in this vicinity. Though soft when taken out, it hardens by exposure, and is light-colored and thick-bedded. Much of the material for the walls of the Aledo jail were taken from the quarries in section 35.

The lower coal seam, No. 1 of the Illinois section, varies in thickness from three to four feet, and it is from this seam that the principal part of the coal for the supply of this region is obtained. From the mine in the southeast quarter of section 1, township 14, range 3, the following section was obtained:

		Feet.	In.
1.	Impure, gray limestone	8	
2.	Flinty limestone	6	
3.	Blue limestone	3	
4.	Black slate	1 foot 6 inches to 2	
5.	Coal	1	6
6.	Slate or shales		4
7.	Slaty coal		4
8.	Coal	1	8
9.	Sandy clay	not measured.	

A little further west the dividing slate under the upper coal was reported to be four feet thick, and at a mine east of this, in section 6, township 14, range 2, it is one foot and eight inches. Where it becomes so thick, the mining is rendered very expensive, and these mines have been abandoned for the present. In sections 3, 4, 5 and 6, township 14, range 2, this seam has been extensively worked. A general idea of the position of the strata may be obtained from a section made at the mines and quarries in section 4:

	Feet.
1. Impure, drab-colored limestone	15
2. Blue limestone	2
3. Coal	4
4. Sandy clay	not measured

The shaly seam, mentioned above as dividing the coal into two parts, is only found at a few mines, and is generally quite thin.

The limestone, No. 1 of the section, is extensively quarried in sections 3, 4 and 5. The rock is mostly in thin layers, from two to eight inches in thickness. The large slabs that form the roof and floor of the cells of the Aledo jail were taken from section 4, and some of the thicker layers were used for the walls of the cells.

The blue limestone, No. 2 of the section, is of little or no value for building stone, as it falls to pieces on being exposed to the weather for a short time. It is sometimes burned for lime.

Large quantities of the gray or drab-colored limestone are taken from the quarries of H. Boone, Esq., in section 34, township 15, range 2. The coal, No. 3 of the last section, is also worked here.

From the mines in section 19, township 15, range 3, and sections 23 and 24, township 15, range 4, the following section was obtained:

	Feet.
1. Sandstone	not measured
2. Limestone	2 to 4
3. Black slate	1 to 8
4. Coal	3
5. Clay shale	not measured

The black slate, No. 3 of this section, in some cases attains a local thickness that was not noticed elsewhere in this county. A number of mines have been worked in section 34, township 15, range 4. In section 12, township 14, range 4, there is a coal shaft near the Edwards river. The following section, obtained in part from the slope above, and in part from the shaft, was furnished me by the proprietor of the shaft, B. C. Talliaferro, Esq., of Keithsburg:

	Feet.
1. Coal No. 2	1 to 1½
2. Slope	12 to 15
3. Clay—very hard and compact	4
4. Quicksand, or decomposed sandstone	3
5. Clay shale—very hard	23
6. Coal No. 1	3½
7. Impure coal, or slate	½
8. White clay	not measured

The coal obtained from this mine is reported to be of good quality. A layer of sandstone in section 8 has furnished considerable building stone, but no work appears to have been done here for some time.

From the mines in sections 20 and 21, township 15, range 1, the following section was obtained:

		Feet.
1.	Sandstone	4 to 6
2.	Limestone	1 to 21
3.	Coal No. 1	3 to 4
4.	Sandy clay shale	8
5.	Limestone	6 to 8
6.	Coal	1 ft. 6 in. to 6

No. 3 of this section is supposed to represent No. 1 coal. It very closely resembles in appearance and position the coal which in other localities in the county is referred to this seam.

No. 6 is reported to have been worked in sections 16 and 20. None of the mines were in operation at the time I was there, and I was unable to make a very satisfactory examination of them. In section 16, at Captain Sisson's mill, this seam was worked by means of a shaft. The coal was reported to be six feet thick, but thinned out towards the east. This may be only a development of No. 1 coal in two divisions, a phenomenon by no means uncommon in other and adjacent counties. As will be seen from the section, these seams are about fifteen feet apart, and nearly half the intervening strata are limestone. A broken coal was reported to have been found in section 1, township 14, range 3, in digging the drain, which at that point is quite deep, and this may correspond with the lower coal of the last section.

In section 34 of this same township, along Parker's run, a coal seam is worked which may belong to coal No. 1, or perhaps to No. 2. There was but one mine open here, and in this, "horsebacks," or slips, are numerous, and the thickness of the coal quite variable. The following section was made here:

		Feet	In.
1.	Sandstone	not measured	
2.	Limestone	2 to 3	
3.	Black slate	2 to 2	6
4.	Coal	2 to 2	8
5.	Sandy clay	5	
6.	Sandstone	not fully exposed	

This seam more nearly resembles coal No. 2, as it is usually found in this county, in quality and thickness, than No. 1; but No. 2 is seldom overlaid by black slate or underlaid by sandy clay, and both are common with No. 1.

Kinderhook Group.—The only strata belonging to this group that I found exposed in this county, are in section 5, township 13, range 5, near the mouth of Edwards river. Quarries have been opened at this point, and in years past much building material has been taken

from here. Both limestone and sandstone, the latter containing considerable magnesia, are found here. These quarries lie but little above the level of the Mississippi, and are overflowed at high water. But little work appears to have been done at these quarries for some time. Fragments of fossils were observed, but nothing perfect enough for identification was obtained.

Economical Geology.

Building Stone.—Mercer county has, in some parts, an abundant supply of this material, both of sandstone and limestone. With but one exception, the quarries are in strata belonging to the Coal Measures. Nearly all the most important sandstone quarries appear to belong to one horizon, which is but a few feet above coal No. 2. This bed is worked in section 21, township 13, range 2, section 9, township 14, range 3, sections 35 and 36, township 15, range 3, and in some other places. When first taken out the stone is quite soft, and is easily cut into blocks of any desired size, but on exposure becomes harder. So easily is this stone worked that an old ax is frequently used, and is all that is necessary to dress the more irregular and uneven beds into shape, and is also frequently used to split the larger ones. These quarries have been opened along the slopes of the hills, where but little material has to be removed to reach the rock; and when heavy stripping is required, the quarries are abandoned and new ones opened. Though this sandstone bed is not continuous, frequently changing into sand or sandy shale, still the workable portions are sufficiently extensive to render the supply inexhaustible.

Another extensive sandstone quarry is in section 19, township 13, range 2. This is probably below coal No. 2, and appears to be near the base of the Coal Measures.

In sections 3, 4 and 5, township 14, range 2, there are extensive quarries of gray or drab-colored limestone. The rock is mostly quite thin-bedded, very few of the layers reaching eight inches in thickness. It is, however, largely used and much liked. This bed is from ten to fifteen feet in thickness, and is separated from coal No. 1, which lies below it, by two feet of blue limestone. The quarries of H. Boone, Esq., in section 34, township 15, range 2, are in this bed. Large amounts of building material have been taken from these quarries, and still the rock has only been worked back for a few feet along some of its outcrops.

A hard, calcareo-arenaceous rock has been quarried to some extent in the northwest quarter of section 15, township 15, range 3. Building stone has also been obtained from the Coal Measure rocks at a number of other places.

The Kinderhook group affords a fair article of building stone, which has been quarried on section 5, township 13, range 5, just north of the mouth of the Edwards river, and on the point of land formed by it and the Mississippi. Both sandstone and limestone are found here, and considerable material has been taken out in times past, though at present the quarries appear to be nearly abandoned.

Limestone for Lime.—Some of the blue limestone, No. 2 of the last section, found above coal No. 1, has been burned, and produces a fair article of lime, but generally needs to be screened before using, and the amount thus obtained is comparatively small.

Coal.—Mercer county has an abundant, though unequally distributed, supply of coal. The upper seam, No. 3 (?), has been found only in sections 31 and 32, township 14, range 2. The coal is from three to five feet thick, and, at the time I was there, there were two shafts and a drift-bank in operation. These mines furnish a large amount of good coal. To the east this seam was reported to thin out within a short distance. On going still farther east it may become thicker, and, should this be the case, the seam may be found and worked in the eastern part of the county. No coal has been discovered from this point for about twelve or fourteen miles up the creek, where a seam, probably coal No. 4, is worked in section 3 of the northwestern township of Knox county. It is thought there is a coal seam in section 5 of this township, lying below the bed of Pope creek, which may be No. 3 (?), and in that case it could, probably, be found between this point and the mines in township 14, range 2, in Mercer county.

The next coal seam, No. 2, has been found over a much larger area. This seam, however, is only from one and a half to two and a half feet thick. At present the only mines in operation are in section 20, township 13, range 2, section 20, township 14, range 3, and in section 1, township 11, range 4. This seam has been opened in a number of other places, but, from one cause or another, the mines have been abandoned for the present. The amount of coal now obtained from this seam is comparatively small, but in most places the quality is good. It probably underlies a portion of townships 13 and 14, range 1, the larger part of township 13, range 2, and the northern part of township 14, range 2, a little of the northern

part of township 13, range 3, nearly all of township 14, range 3, the northeastern part of township 14, range 4, a part of township 15, ranges 2 and 3, the northwest part of township 15, range 4, and the uplands of township 15, range 5. Although it has not been found in township 15, ranges 4 or 5, I think it may be, from the fact that in or near section 21, township 16, range 5, Rock Island county, a two-foot seam of coal, resembling No. 2, is worked. This coal is found but little above the bed of Copperas creek, and the mines are only about three miles from the north line of township 15, range 5. The coal is worked both by drifts and a shaft, and is said to be of excellent quality. Traces of coal were reported to have been discovered in or near section 8, township 15, range 5, and if so, it may belong to this seam.

The lower seam, No. 1, affords the larger part of the coal now used in this county. It is from three to four feet thick, and underlies a large area, but is most extensively worked in township 14, ranges 2 and 3, and township 15, ranges 1, 2 and 4. It probably underlies township 13, ranges 1 and 2, townships 14 and 15, ranges 1, 2, 3 and 4, and perhaps a portion of township 13, ranges 3 and 4, and township 15, range 5. Coal No. 1 is not always found where No. 2 is developed and its proper horizon is exposed, as, in some places, particularly along the outer edges of the coal-field, the lower part of the measures were not deposited very regularly, and hence, in some of the above-named places coal No. 1 may not be found. In section 19, township 13, range 2, the rock at the quarries has the appearance of belonging to the Conglomerate, at the base of the Measures, which lies below coal No. 1, although No. 2 is found at the bottom of the bluff, within about two miles up the creek, and the strata appeared to be nearly horizontal. At some of the mines the coal from this lower seam is not of the best quality, there being much slaty material with it which requires to be sorted out before it is sent to market. This is not always carefully done, and thereby the value of the coal and the reputation of the mine is much injured.

In searching for these lower seams, it is well to know beforehand whether the Coal Measures are present and upon what they rest, though it seems probable that some of the strata belonging to the coal series will be found throughout the county, with, perhaps, the exception of the bottom lands of the Mississippi.

None of the underlying strata have been seen in townships 14 and 15, but the coal seam worked along the Edwards is most likely the lowest one, unless the lower one found in Richland Grove, township

15, range 1, should prove to be a different seam. This lower seam was recognized with certainty at but two places, about a mile apart, and was reported to be, in each case, about fifteen feet below the seam supposed to be No. 1, and it is not improbable that this may prove to be only a lower division of No. 1. In section 1, township 14, range 3, the strata dip as the entry runs back from the mouth of the mine, hence they were obliged to make the drain quite deep, and in digging this they found a broken coal about fifteen feet below the one they work, which is probably the lower division of the seam.

In township 13, ranges 1 and 2, the Coal Measures may rest, at least along the southern border, upon the Burlington limestone, though it is not certain that this group extends as far north as this, but it is not improbable. Should it be present, it will form a horizon readily recognized, below which coal need not be looked for, as the light-colored crinoidal, or even the brown arenaceous limestone is very different in appearance from the limestones of the Coal Measures, which are usually dark-colored and fine-grained.

From the southern part of Henderson county, where the Burlington limestone outcrops, to its most northerly exposure, at Bald Bluff, the strata rise gradually. East of here, at the most northerly exposure of the junction of this group with the Kinderhook, in section 35, township 12, range 3, in Warren county, it is nearly twenty feet above the level of Cedar creek, and probably not less than forty to sixty feet above the Mississippi. At this point the whole of the Burlington rocks appear to be exposed, and do not exceed thirty-five or forty feet in thickness. East of here they are exposed a very little farther north, when they disappear beneath the Coal Measures. In range 3, the surface of which is considerably lower for some distance than that of ranges 1 and 2, it will not probably be found north of section 35, township 12. All the stratified rocks that have been observed north of this in this township appear to belong to the underlying Kinderhook group. Hence, it seems probable that along some portions of the southern border of Mercer county the Coal Measures rest upon the Kinderhook group. As the latter is here composed of shales much resembling those of the Coal Measures, it will be very difficult, if not impossible, for the miner, who knows nothing of geology, to tell when he has reached the horizon below which coal cannot be found, and he may dig or bore into the lower Carboniferous beds without the slightest prospect of reward for his labor.

A much larger amount of coal might be taken out in this county were the demand sufficient to warrant it, none of the mines being

worked to their full capacity at the present time. The railroad now being constructed intersects the county from east to west, and runs within three miles of nearly all the mines along Edwards river, while some of them are much nearer, and those along Pope creek, sections 31 and 32, township 14, range 2, are less than four miles from it. It is probable that at almost any place between Windsor and Monroe a shaft might be sunk, near the railroad, and reach a workable seam of coal at a depth not exceeding one hundred and fifty or two hundred feet. This road once in operation, new mines will be opened, and sections that are now unable to obtain coal at reasonable rates will be supplied, while those who have coal lands near the road will find their value much increased.

Pyrite.—This is a sulphuret of iron, and the so-called "sulphur" of the miners. It is more or less mixed with the coal of all the seams. and is the great bane of all our western coals. It occurs in various forms, sometimes in crystals and thin vertical layers disseminated throughout the coal, and again in horizontal bands. In the latter case, it is readily separated from the coal in the mines, but in the former this cannot be done. If much of it be present the coal is valueless for blacksmithing purposes, as it renders the iron brittle. If the coal is to be used in the manufacture of iron, the sulphur of the pyrite may be removed by coking. This mineral is of no value, save for the manufacture of copperas (sulphate of iron) and sulphuric acid.

Timber, Soil and Agriculture.—The soil of the prairie is a dark-colored or black loam, containing much humus, and everywhere productive when properly drained and cultivated. Corn and other cereals are the principal crops. The soil of those portions which skirt the water courses is usually much lighter-colored and of less depth than that of the prairie. Though much less productive, it is better adapted to some crops, particularly fruits. Nearly all these lands were originally timbered, but large portions of them have been cleared, either to obtain fuel or for cultivation. The most abundant kinds of timber found here and along the slopes of the hills are white, burr, black, red and laurel oak, red and white elm, blue and white ash, bitternut and scaly-bark hickory, sugar and white maple, wild cherry, and red-bud, with occasionally black walnut, butternut and American aspen. In the creek bottoms there are, in addition to these, honey-locust, sycamore, cottonwood, ash-leaved maple or box-elder, buckeye, wild plum, thorn and crab-apple. Grape vines and other climbers are abundant.

The bottom lands of the Mississippi are in part prairie and in part covered with a heavy growth of timber, consisting of sycamore, cottonwood, black walnut, butternut, red and white elm, white and sugar maple, buckeye, coffee tree, honey locust, hackberry, and the common varieties of oak, hickory and ash. This land is very fertile and produces large crops of hay, corn, etc.

A large portion of townships 14 and 15, range 6, is comparatively low land, and valuable principally for timber, grazing and meadow. Some parts of this produce immense quantities of a coarse grass, which is much liked by cattle, and hence stock growing is extensively carried on in some portions of the county.

Other portions of these bottom lands are very sandy and the soil poor, but in wet seasons comparatively large crops may be raised here by proper cultivation and fertilizing. Irish and sweet potatoes do better here than on the prairies. Some portions of this sandy land is covered with a scrubby growth of timber, consisting of black-jack, black, white and red oak, and shell-bark and bitternut hickory

CHAPTER XXXI.

KNOX COUNTY.

Knox county comprises a superficial area of twenty townships, or seven hundred and twenty square miles. It is bounded on the north by Henry county, on the east by Stark and Peoria, on the south by Fulton, and on the west by Warren and Mercer. The fourth principal meridian passes along its western border, and it embraces townships 9, 10, 11, 12, and 13 north, of ranges 1, 2, 3 and 4 east.

The southeastern part of the county is intersected by Spoon river, which enters it in township 11, range 4, and passes out in township 9, range 2. French and Littler's creeks lie to the east, while Haw and Court creeks, with their branches, the larger of which are Brush, Middle, North and Sugar creeks, lie on the west. In the northeast is Walnut creek, a branch of Spoon river, while in the northwest Cedar, Main Henderson and Pope creeks have their origin, and run to the westward. By these and some smaller streams this county is well watered. Springs, though not numerous, are occasionally found along the lower lands. Good wells may generally be had at depths varying from fifteen to fifty feet.

A large proportion of the county is prairie, but so numerous are the streams that the prairies are commonly but a few square miles in extent. The soil does not present any material difference in appearance from that of the other counties in this part of the State, and is of the usual dark-colored, vegetable loam, with a brown clay subsoil. That along the water courses is generally of less depth and lighter in color.

Surface Geology.

This embraces the usual sub-divisions of the Quaternary, with the exception of the Loess, which was not noticed. The Alluvial deposits are not extensive, seldom over a mile or so in width, and commonly much less, and comprise the bottom lands found along nearly all the water courses. The soil is a dark-colored loam, frequently intermingled with sand and gravel.

The Drift is spread over the entire surface of the uplands to a depth of from ten to sixty feet, perhaps occasionally a little more. It comprises a series of yellow and blue clays, here and there mixed with sand and gravel. Boulders of igneous and metamorphic rocks are not uncommon in it, and may frequently be seen along the courses of the streams. Wells are not usually sunk entirely through this deposit, an abundant supply of good water being commonly found before the beds of the Coal Measures are reached, though occasionally they go deeper, and good water is sometimes obtained in the Coal Measures.

All the stratified rocks exposed in Knox county belong to the Coal Measures, and they comprise a series of sandstones, limestones, clays, shales and seams of coal, and represent the middle and lower part of the series, from coal No. 5 of the Illinois section to coal No. 1, inclusive.

The upper seam, No. 5, is found principally in the eastern half of the county. It varies in thickness from four to six feet, and affords a good quality of coal. In this and the adjoining counties it has a clay band about a foot and a half or two feet from the bottom, and frequently several other clay partings, as the two sections given below will illustrate. No. 1 was taken from a mine in section 15, township 10, range 4, and from section 32, township 12, range 4:

	No. 1.		No. 2.	
	Ft.	In.	Ft.	In.
1. Coal	2	10	1	8
2. Clay		¼ to ½		½
3. Coal	1		1	
4. Clay		1 to 2		3
5. Coal		8		6
6. Clay		½ to 1		½
7. Coal		11	1	

No. 4 of this section is nearly always present, but is occasionally replaced by clay shale, and rarely pyrite. Partings Nos. 2 and 6 are quite variable, always less than No. 4, and frequently wanting or marked by a band of shale or pyrite. The principal clay part-

ing, No. 4 of this section, is largely used as a mining seam. The clay having been removed, the coal above is broken down and that below taken up.

In the western half of township 12, range 4, this coal seam has been extensively worked. Mines have also been opened in sections 4, 5, 17, 18, 19, 29, 30, 31 and 32. A section of the strata on section 12 gave:

	Feet.	In.
1. Clay shale	not measured	
2. Limestone	1 to 3	
3. Slaty or clay shale	6 in. to 4	
4. Coal	2 to 2	8
5. Clay, mining seam	2 in. to	3
6. Coal	1 ft. 6 in. to 2	
7. Clay	2 to 4	
8. Sandstone		

In some mines this coal runs as thick as six feet, but the section above given shows its more common thickness. At the mines of P. Peterson, Esq., in the northwest part of the northwest quarter of section 32, and some others in the vicinity, the coal was thicker than in the northern part of the township. The overlying limestone is here quite hard and durable, and is worked somewhat for building stone. In township 12, range 3, mines have been worked in sections 1, 10, 11, 18, 19 and 20. East of Wataga, township 12, range 2, in sections 13, 15, 22, 23 and 24, much coal has been taken from this seam. From the mines of John A. Leighton, Esq., in section 12, the following section was obtained:

	Feet.	In.
1. Clay shale	not measured	
2. Limestone, 1 foot 6 inches to	2	
3. Clay		6
4. Black slate, 8 inches to	2	
5. Coal	4	2
6. Clay	not measured	

The clay parting here varied from two to four inches in thickness. Near the center of section 24 limestone is found in considerable quantities, which makes good lime.

In township 11, range 3, there are mines in sections 3, 4 and 5, and the coal is reported to belong to this seam, and to be from four to five feet thick. In section 15, township 10, range 4, the coal appears along the bluff a number of feet above the stream. The following section was obtained here:

	Feet.	In.
1. Limestone	1 to 4	
2. Clay, containing limestone nodules		6
3. Coal, clay parting from one to two inches thick	5	8
4. Clay	10 to 12	
5. Sandstone	3 to 5	
6. Clay shale	8 to 12	

The limestone, No. 1 of the section, is worked at this place, and the following fossils were obtained from it: *Productus Prattenianus, Chonetes Flemingii, Yoldia Knoxensis?* and some others not identified. This limestone is again exposed and worked in the southeast quarter of section 25, township 9, range 4. It is quite hard at this point, and makes a valuable building stone, and being four feet thick can be quarried more readily than at most other points in this vicinity, where it is thinner. It also forms a good roof for the coal below, there being but six inches of shaly limestone between. This seam is worked in sections 23, 24, 31 and probably in 32 and 33. There is also a mine in section 35, township 9, range 3. At this point the coal is found high up in the hill, and is reported to be somewhat rotten.

The mines formerly worked by Messrs. Camp and Powell at Oneida, section 36, township 13, range 2, also belongs to this seam. The mine was closed at the time I was there, so that I was unable to make any examinations. The seam was reported to be quite thin, but with the usual clay parting.

The following analysis of three specimens of this coal are taken from the first volume of this report, and were made by Dr. BLANEY, of Chicago:

	Weight of a cubic foot.	Moisture.	Volatile combustible matter.	Carbon in coke.	Ashes.	Coke.
1	78.4855	12.0	27.2	55.2	5.6	60.8
2	81.5112	8.8	30.8	58.0	2.4	60.4
3	79.4892	11.6	29.3	55.9	3.2	51.1

No. 1 was from near the top of the seam; No. 2 from just above the clay band, and No. 3 from below this band.

This seam is only found in the higher portions of the county, which are principally in the eastern half, and north of Spoon river. The river divides this seam, leaving a small portion in the southeastern part of the county. Here it is found along Kickapoo and and Littler's creeks, in township 9, range 4, and probably underlies the lands between the two in the southeastern part of the township. At a single point in section 15, township 10, range 4, there are some mines that appear to belong to this seam. North of Spoon river this seam underlies the western half of Victoria, township 12, range 4, a portion of the northern and western parts of Copley, township 12, range 3, and a part of the eastern half of Sparta, township 12, range 2.

At most of the mines in the county this coal is of good quality, and no other seam, unless it be No. 2, furnishes as good black-

smith's coal. "Horse-backs," or slips, are not very numerous, though occasionally occurring. At present this is the most valuable seam worked in the county.

The next seam, No. 4? of the Illinois section, usually lies from forty to sixty feet below this one. As there is no place in the county where the two are exposed, I was unable to obtain a section of the strata between them. This coal is seldom less than three, or more than four feet in thickness. Mines, which appear to be in this seam, are worked in sections 2 and 3, township 13, range 1. A section obtained from here showed:

		Feet.	In.
1.	Limestone	1	6
2.	Clay shale	8 to 10	
3.	Coal	3 to 5	
4.	Clay	3	
5.	Sandstone	not measured.	

These are the only two coal mines that have been opened in this part of the county, and there are none in the adjoining parts of Mercer and Henry counties. A mine has been opened in this seam in the eastern part of section 25, township 12, range 4. No work was being done at the time I was there, but another mine, just over the line in Stark county, was open. As they are but a short distance apart, the following section, which was taken from the latter, will probably show the general character of the strata:

		Feet.	In.
1.	Limestone	3	
2.	Clay shale	10 to 12	
3.	Coal	4 to 6	
4.	Impure cannel coal	6 to 10	
5.	Clay	not measured.	

In the cannel coal, No. 4 of this section, there are the remains of fishes and plants, some of which are beautifully preserved, though generally quite fragmentary.

The mines along Sugar creek and its branches, in township 12, range 3, may belong to this seam, or perhaps to No. 5, but as none of the banks were open, I could not make the necessary examinations to determine this point. The coal furnished by these mines was reported to be of superior quality, and this would seem to indicate that it belonged to No. 5.

The mines in sections 9, 16 and 32, and along Middle creek and its branches, in the northwest part of township 11, range 2, also those in section 25, township 11, range 1, are probably in coal No. 4.

South of Spoon river there are a number of mines along Littler's creek, in sections 26, 27, 28, 34 and 35, township 9, range 3. A section here gave:

		Ft.	In.		Ft.	In.
1.	Black slate	1	3	to	2	
2.	Coal	3	6	to	4	6
3.	Fire-clay	1	6	to	2	

The mines in section 3, township 9, range 4, and sections 26 and 27, township 10, range 4, may also belong to this coal, but the evidence was quite unsatisfactory. The following section was reported from section 26:

		Feet.
1.	Sandstone	3 to 5
2.	Clay shale	8 to 12
3.	Clay	2
4.	Black slate	2 to 4
5.	Coal	2 to 3
6.	Clay shale	not measured.

This seam, though not as extensively worked as No. 5, underlies a much larger portion of the county. It probably underlies township 13, ranges 2, 3 and 4, and the eastern part of range 1.

A short distance southwest of Milroy, a thin seam was reported somewhere from twenty to forty feet below the one now worked there, which appears to be No. 4. Should this lower seam be No. 4, it is much thinner here than it is usually, and it is more probably No. 5. It probably underlies township 12, ranges 2, 3 and 4, township 11, range 2, and the southeastern part of range 1, and the northern borders of ranges 3 and 4, perhaps the eastern part of township 10, range 4, and township 9, range 4, and the southern half of range 3. The coal from this seam is generally of fair quality, but is a little harder and not as well liked as that from No. 5.

In township 10, range 1, there is a coal seam worked in several places, which may be No. 3 (?) of the Illinois section. The exposed strata in section 23 showed the following succession:

		Ft.	In.		Ft.	In.
1.	Clay or clay shale, rotten	not measured.				
2.	Coal	4		to	5	
3.	Sandstone and shale	10		to	15	
4.	Clay shale				7	
5.	Black slate		6	to	1	3
6.	Clay shale				4	
7.	Coal No. 2	1	6	to	2	3
8.	Fire clay	not measured.				

Abundance of fossil plants were found in some portions of the shale overlying the upper seam of this section, among which are: *Pecopteris villosa, P. polymorpha, Neuropteris rarinervis, Stigmaria Evani, Sphenopteris intermedia, Annularia longifolia, A. sphenophylloides* and *Pinnularia capillacea*. All these plants are found in connection with coal No. 2 of the Illinois section, and have not hitherto been observed in connection with No. 3 in this portion of the State.

The lower seam is considered by the miners to be the same seam as that worked near Avon, ten or twelves miles southeast of this, which is referred by the best authorities to coal No. 2. The upper seam at this place agrees very nearly with the one found in section 17, township 8, range 2 west, in Warren county. The lower seam, No. 7 of the section, is worked in several places in section 23, but the upper one only on the farm of Deacon Andrews, in the southeast quarter of the section. The coal furnished by this mine is rather soft, kindles easily, and has a good reputation.

A portion of the mines worked in section 10 of this township appear to be in this seam.

A section at this point gave:

		Feet.
1.	Calcareous clay or shale	not measured
2.	Coal	3 to 6
3.	Calcareous clay or shale	7 to 9
4.	Coal	5 to 6
5.	Blue clay or shale	about 20
6.	Coal	2

No. 6 of this section I consider to be coal No. 2, and No. 4 of this section I consider to be the equivalent of the upper coal in section 23. No. 2 of this section may be only a division of the coal below it, or it may be a separate seam, perhaps coal No. 3. The equivalents of either of these seams have not been recognized elsewhere in the county.

Near the former site of Dr. E. Hall's mill, section 5, township 13, range 1, there is an outcrop of limestone along Pope creek, close to the water's edge. It is supposed that there is a bed of coal but a few feet below this, but the matter had not been thoroughly tested when I was there. Should it prove to be so, it seems quite probable that it may be the same seam, No. 3 of the general section, and the same as the upper one found in the southwestern part of township 14, range 2 west, in Mercer county. Much of the limestone at this outcrop is highly fossiliferous, and contains many well preserved remains. The following fossils were obtained here: *Spirifer cameratus, S. planoconvexa, Productus longispinus* var. *muricatus, P. Prattenianus, P. Nebrascensis, Chonetes mesoloba, Avicula longa, Aviculopecten pellucida, A. carbonarius, A. occidentalis, Lima retifera, Nucula parva, Edmondia ovata, Entolium aviculatum, Allorisma Geinitzii, Yoldia Knoxensis?* and *Leda bellastriata, Bellerophon ellipticus, B. Montfortianus, B. Meekianus, B. percarinatus, Pleurotomaria Grayvillensis, P. sphæruluta, Macrodon, Machrocheilus inhabilis, Polyphemopsis peracuta, P. inornata, Pleurophorus, Nautilus* and *Orthoceras cribrosum.* Of these, *Allorisma Geinitzii. Leda bellastriata, Nucula parva,* and *Pleurophorus ?*

have been referred by Prof. GEINITZ to the following European Permian species: *Allorisma elegans*, *Nucula Kazanensis*, *N. Beyrichi*, and *Pleurophorus Palasii*. Some of these species are found in connection with the lowest coals. (See the description of coal No. 1 in the report on Warren county.) For the identification of the above named fossils, and for other points of interest, I am indebted to Mr. F. B. MEEK.

The next coal seam, No. 2 of the Illinois section, is generally from a foot and a half to three feet in thickness. This coal is considered fully equal in quality to that of any other seam found in the county. In township 12, range 1, a coal that appears to be the equivalent of this seam is worked in sections 20, 21, 29, 30, 32 and 33. The seam is from two to three feet thick, with from one to three feet of clay shale, and a band of limestone above, and a floor of fire-clay. In section 23, and near the southeast corner of section 16, township 11, range 2, it is again worked. From here along down Court creek to its mouth, and on some of its branches, this seam has been more or less worked in sections 19, 22 and 23, township 11, range 3; also in sections 13 and 35. In Truro, township 11, range 4, it appeared in or near the bed of Spoon river, and has been worked at various places. From here there are outcrops along the river, at intervals, to near the south line of the county. The exposure near the river bridge, section 12, township 10, range 3, shows the following succession:

		Ft.	In.		Ft.	In.
1.	Clay shale	not measured.				
2.	Limestone	0	3	to	0	4
3.	Clay shale				3	0
4.	Calcareous iron ore				2	3
5.	Clay shale				2	3
6.	Limestone	0	6	to	0	9
7.	Clay shale				1	3
8.	Limestone					2
9.	Arenaceous shale					3
10.	Limestone	0	2	to	0	3
11.	Clay shale				6	6
12.	Black slate				3	0
13.	Coal	1	8	to	3	0
14.	Clay	not measured.				

The limestone, Nos. 2, 6, 8 and 10, contain a greater or less percentage of carbonate of iron. From the shales and limestones were obtained *Productus Prattenianus*, *P. Nebrascensis*, *Athyris subtilita*, *Chonetes mesoloba*, *Lingula umbonata?* and other fossils.

West of the river, in township 10, range 3, this seam is worked in sections 8, 16, 18, 19 and 29, also in township 10, range 2, in sections 14, 22, 23, 25, 26, 27, 29, 33 and 34. In section 33, along Hog creek, specimens of "cone-in-cone" were found in considerable

quantities. West of this the coal has been found in sections 10, 14 and 23. The exposure in the bluffs of Brush creek, in the northeast quarter of section 14, gave:

	Feet.	In.
1. Sandstone	not measured.	
2. Shale	not measured.	
3. Black slate	not measured.	
4. Clay shale	6	6
5. Coal	2	2
6. Clay shale or clay	3	
7. Sandstone	not measured.	

Nos. 1, 2 and 3 of the above sections were only exposed sufficiently to determine their lithological characters, but not so as to be accurately measured. The following section was obtained in section 10:

	Feet.
1. Clay or shale	not measured.
2. Coal	3 to 6
3. Clay or shale	7 to 9
4. Coal No. 3	5 to 6
5. Clay shale	20
6. Coal No. 2	2
7. Sandstone	not measured.

Seams that appear to be the same as Nos. 4 and 5 of this section are worked in section 23, and the plants obtained from the overlying shales of the upper bed are the same as are found elsewhere in connection with No. 2. This would indicate that the lower coal might be No. 1 of the general section of the coal strata in the Illinois River valley, as given in the third volume of the original reports, and that the others are the equivalents of coals No. 2 and 3 of the same section, to which they correspond more decidedly in their general features than with the higher beds. They are, however, considerably thicker here than coals Nos. 2 and 3 average in other portions of the State, but as the local thickening of the coal is not an uncommon occurrence, no definite conclusion can be based on that character alone. It may be, however, that the lower coal in the above section will prove to be No. 2, and that the beds above either represent coals 3 and 4, or an unusual local development and division of No. 3 only. If this proves to be the true solution of the question, it shows that the fossil plants usually found in the roof shales of No. 2, also occur sometimes in connection with the higher seams.

The lower coal in the above section is also worked in township 9, range 1, section 17, and the mines in section 36 probably belong to it. The seam there is about three feet thick. In township 9, range 2, it is worked in sections 6, 8, 9, 27 and 31. Along the little run that intersects the western part of section 31, a coal that appears

to be the same has been worked high up in the bluff, and in the bed of the run the lower coal, No. 1, crops out.

No. 2 is worked either by stripping or drifting. Along the bluffs of the streams and in the hillsides where it crops out, it is frequently the case that but a few feet of other material lies over it, and by stripping this off, large amounts of coal are obtained at a small expense. At no place in the county is this seam worked by means of a shaft, but in those parts where it attains a thickness of from two and a half to three feet, it may hereafter be profitably worked by this method.

The lower seam, No. 1, is not worked to any extent in but one locality in Knox county, on section 21, township 12, range 1. It is here worked by means of a shaft, which is about thirty feet deep. The coal is six feet thick, but as much of the roof is not very firm, and the upper part of the coal is of inferior quality, from one to two feet of coal is left to strengthen the roof. In section 36, township 9, range 1, this seam has been found several feet below the bed of the little stream that passes through it. In section 31, township 9, range 2, it crops out in the bed of a small run, and a little coal has been taken out here. South of this, and just over the line in Fulton county, the strata exposed in the bluff of Cedar Fork show the following section:

	Feet.	In.
1. Clay shale.....not measured.		
2. Coal No. 2.....about	3	
3. Shale and slate.....	35 to 40	
4. Coal, upper division of No. 1.....		10
5. Shale.....	8 in. to 1	2
6. Sandstone.....	6 in. to	9
7. Clay shale.....	1	
8. Black slate.....	3	6
9. Coal No. 1.....about	3	

None of the mines in either seam were open when I was at this place, and hence I was unable to measure the coal accurately. It seems probable that this coal, and also No. 2, underlies nearly, if not the whole, of Knox county.

While the strata of the Coal Measures dip, locally, in almost every direction, they appear to have a general inclination to the southeast, save, perhaps, in the northwestern part of the county, and here I do not know the direction. The dip, however, is not regular, but seems to be quite undulating.

Coal No. 2 first outcrops in the bed of Walnut creek, in section 17, township 12, range 5, in Stark county. South of this it is not again exposed, as far as I learned, between that point and section

14, township 11, range 4, in Knox county. From this point, Spoon river, with its various windings, runs to the west for about five miles, and then south about nine miles, from whence it passes to the southwest till it leaves the county. From where this coal first appears in Knox county, it is occasionally exposed along the river and near its bed, to a point a little beyond where the river turns south. In the northwest quarter of section 6, township 10, range 4, it lies low in the bed of the river, and is frequently torn up in considerable quantities by the currents at high water, and is sometimes worked when the river is very low. Some two or three miles south, near the bridge, it appears a little above the bed of the river. At Burnett's mill, section 34, township 10, range 3, the coal lies some ten or more feet above the river level, but southwest of this, in section 10, township 9, range 3, it is worked in the bed of the river. In sections 26 and 27, township 9, it again appears, but how much above the bed of the river I did not learn. A mile and a half west of this it crops out along a branch of Spoon river, and about fifteen feet above its bed. South of here, this coal is not worked along the river in this county, as far as I could learn.

Economical Geology.

Stone for Building.—Knox county has but a limited supply of good building stone. Some portions, however, have sufficient for their own wants. North of Knoxville, in the western half of sections 16 and 21, township 11, range 2, quarries have been opened in a heavy sandstone bed. Some portions of the rock do not appear to be of much value, while others, though soft, form a durable material for the use of the builder. This rock appears to lie above coal No. 2, and is probably the equivalent of a similar bed, in this position, in Mercer county. In the northeast quarter of section 16, there is a quarry that affords an entirely different rock. It is a dark drab-colored conglomerate, spotted by darker slate-colored pebbles. By exposure it changes, on its surface, to a lighter and yellowish color that is mellow and pleasing in its effect. It is compact, moderately hard, and makes a valuable building stone. The foundation stone of the "fire-proof" building attached to the court house in Knoxville, was obtained from this locality.

Sections 27, 33 and 34, township 10, range 2, furnish some building stone. Some of the other localities are sections 14, township 10, range 3; section 27, township 10, range 4; and sections 21, 27, 35

and 36, township 9, range 3. Some of these quarries are large, and considerable amounts of material have been taken from them.

The band of limestone which lies just above coal No. 6, and is from one to four feet thick, has been considerably worked, when so exposed as to be readily obtained. One of the largest quarries in this limestone is south of Yates City, in section 25, township 9, range 4. The bed is here four feet thick, and yields a hard, dark-drab or grayish-colored, compact rock, which readily breaks into blocks of good shape for building purposes.

Limestone for Lime.—This is rarely found in any abundance. In township 12, range 2, near the center of section 24, considerable quantities of limestone are found, which is manufactured into lime, yielding a fair article. Elsewhere the manufacture has been attempted only on a small scale. For the most part Knox county has to depend upon localities more favored in this respect, for its supply of lime.

Coal.—The best and largest amount is furnished by the upper seam, No. 5. This is principally worked in township 12, range 2, 3 and 4, and in townships 9 and 10, range 4, This seam is from four to six feet thick, and at many of the mines it is comparatively free from foreign substances, and hence requires but little sorting. "Horsebacks," or slips, which, in some places greatly injured this seam, are not so numerous in this county as elsewhere. The coal is somewhat lighter than that from seam No. 4, and is preferred by blacksmiths.

No. 4* furnishes the northwestern part of the county with a good supply of coal of a fair quality, and the mines in this seam are among the best in the county. Nearly all the coal obtained in township 11, range 2, is, probably, from this seam, and also that from township 9, range 3. It is also worked in some other places, and affords a coal of good quality, and harder than that from No. 5. It does not kindle as easily but lasts longer, and for some purposes is preferred.

Coal No. 3.—This is worked in township 10, range 1, and furnishes a good coal, and the larger part of the supply for this section.

---

* It is quite probable that No. 5 is also locally developed in this county, but there is no very decided features pertaining to this seam that will serve to distinguish it from No. 6. Unless both are exposed, it is very difficult to decide positively whether an outcrop of a single seam at about this horizon, belongs to one or the other of these coals. The quality of the coal it affords is more like No. 6, while the roof shales and limestone above it, correspond more nearly with No. 5. In Fulton county, the distance between these coals, when all three are present, is only about thirty-five feet, and when No. 5 is not developed the distance between Nos. 4 and 6 is about sixty-five to seventy feet.

A. H. W.

The remaining portions of the county are supplied by mines which, probably, are in coal No. 2. At most places where worked, this coal is of excellent quality, and usually pretty free from admixture with other substances. It is largely used for, and well adapted to, blacksmithing purposes. Though this is the thinnest seam worked, yet the amount obtained from it is quite large.

Coal No. 1 was only recognized at one point in the county, on section 21, township 12, range 1.

From this it will be seen that Knox county is abundantly supplied with good coal, there being but three townships in which coal is not mined now, viz: township 13, ranges 2, 3 and 4, and in two of them it has been worked formerly, and probably not less than two workable seams may be found in every part of these townships.

CHAPTER XXXII.

STARK COUNTY.

Stark county is bounded on the north by Henry and Bureau counties, on the east by Putnam and Marshall, on the south by Peoria, and the west by Knox and Henry. It has a superficial area of eight townships, or two hundred and eighty-eight square miles. It embraces townships 12 and 13 north, of range 5 east, and townships 12, 13 and 14 north of ranges 6 and 7 east.

Spoon river intersects the county from north to south. In the northeastern part of township 13, range 6, the river branches—the West Fork passing through township 14, range 6, and the East Fork through township 14, range 7. In the southern part of the latter township, is Cooper's Defeat creek. In the southeastern part of the county are Camp and Mud runs, and in the southwest is Walnut creek. Indian creek rises near the northern part of township 13, range 5, and empties into Spoon river just above Slackwater. By these and some smaller streams, this county is well watered. Springs are occasionally found along the lower lands, but are not abundant. Good wells may generally be had at depths varying from fifteen to fifty feet.

A large portion of the county is prairie, but on account of the numerous intersecting streams the prairies usually contain but a few square miles of area. There are, however, some large prairies in townships 12 and 13, range 7. The soil is similar in appearance to that of the other counties in this part of the State, and is of the common dark-colored loam, which, when properly drained and cultivated, is everywhere productive. The subsoil is usually of a brown or yellow clay. The soil of the timbered lands along the watercourses is usually of less depth and lighter in color.

Surface Geology.

Two of the subdivisions of the Quaternary are found in this county —Alluvium and Drift. The Alluvial deposits comprise the bottom lands found along nearly all the water-courses, but they are seldom over a mile in width, and generally much less.

The Drift, which comprises a series of brown and blue clays, locally intermingled with sand and gravel, is spread over the entire surface of the uplands to a depth of from twenty to fifty feet, and perhaps in some places a little more. Boulders of the older rocks are not uncommon in it, and frequently lie scattered along the water courses. These are most commonly granite, or belong to that class of rocks closely related to it. Wells are seldom sunk through this formation, an abundant supply of good water being commonly found before the lower beds are reached.

All the stratified rocks that are exposed in this county belong to the Coal Measures, and include all the lower portion of the series, from coal No. 7 to coal No. 2, inclusive. Lower than this the rocks are not exposed.

Coal No. 7, of the Illinois valley section, has been found only at a few places, It has been worked in or near the north line of section 10, township 14, range 7, along East Fork. In section 10, a shaft has been sunk by Mr. S. C. Francis, which affords the following section:

		Feet.	In.
1.	Yellow clay	2	
2.	Red sand	2	
3.	Limestone, nodular	2	4
4.	Clay, light-colored	6	10
5.	Clay shale	2	
6.	Sandstone		8
7.	Blue clay shale	4	2
8.	Sandstone	1	4
9.	Blue clay shale	8	
10.	Dark-colored clay shale	5	8
11.	Coal		2
12.	Blue clay shale	12	
13.	Impure limestone		3
14.	Clay shale	8	0
15.	Impure limestone		2
16.	Blue clay shale	1	4
17.	Dark-colored clay shale	3	1
18.	Coal	2	7
19.	Clay, penetrated	1	8

The shaft had not been sunk any farther at the time I visited it —in the fall of 1868—neither had the coal, No. 18 of this section, been tested. This coal appears to occupy the position of coal No.

7, and probably belongs to that seam. The coal worked at the Bradford shaft, which is but a short distance from here, in section 21, is thought to lie some thirty or forty feet below, and is probably No. 6. In section 32, township 10, range 7, this coal has been worked a little, by stripping along Mud run.

Coal No. 6 is the principal seam worked in the county. It first appears in the bluff of West Fork, in the southeast part of section 3, township 14, range 6. From this point to the southeast quarter of section 16, it has been worked at intervals along the west bluff of the creek. At the latter place numerous openings have been made and large quantities of coal taken out. The coal here crops out of the bluffs some ten or fifteen feet above the bed of the creek, is four and a half feet thick, and has a two-inch clay parting near the middle of the seam. In township 14, range 7, section 28, this seam is worked at the Bradford shaft, which is located on the east bank of East Fork, and near the north line of the section. I am indebted to S. C. Francis, Esq., for the following section of this shaft:

		Feet.	In.
1.	Yellow clay	3	
2.	Limestone	4	
3.	Light-colored clay	4	6
4.	Light-colored clay shale	8	4
5.	Limestone	2	4
6.	Clay shale	9	10
7.	Coal		2
8.	Soft black slate		4
9.	Clay	4	5
10.	Sandstone	22	3
11.	Clay shale	6	
12.	Limestone	4	
13.	Light-colored clay shale	6	
14.	Green clay shale	2	4
15.	Dark-colored clay shale	3	2
16.	Limestone, impure	1	6
17.	Dark-colored clay shale	2	6
18.	Coal, with 3 inch clay parting	3 to 5	

"Horsebacks" or slips are very numerous in this mine, rendering the working of it quite expensive.

Near the junction of East and West Forks, and in the northern part of section 1, township 13, range 6, other shafts have been sunk. The shaft at Modena, in the southern part of section 1, furnishes the following section:

		Feet.	In.
1.	Drift	variable.	
2.	Sandstone, sometimes not present	1	
3.	Blue clay	8 to 10	
4.	Clay shale	12 to 14	
5.	Impure blue limestone	2	
6.	Coal	4 ft. 6 in.	5 6

West of this, in the northern part of section 4, this coal appears in the bed of Jack creek, and has been worked a little. Farther down the creek, in sections 2, 11 and 12, it crops out along the stream, from eight to ten feet above it. A number of mines have been opened at various points in these sections. Along a little branch that enters Spoon river, near the north line of section 14, this seam outcrops some ten or more feet above the stream. The exposure in this locality gave the following succession of strata:

		Feet.	In.
1.	Sandstone	not measured.	
2.	Clay shale	12 to 15	
3.	Impure limestone	1 to 2	
4.	Clay shale	1	6
5.	Black slate		6
6.	Coal	2 to 4	
7.	Clay parting		2 to 3
8.	Coal	1 ft. 6 in.	2
9.	Clay or clay shale	3 to 4	
10.	Sandstone	not fully exposed.	

The black slate over the coal contains numerous fossils, but mostly imperfectly preserved. Among those obtained are, *Cardinia fragilis? Aviculopecten rectilaterarius, Discina nitida, Pleurotomaria Grayvillensis*, together with some fish remains.

No. 10 of this section is worked for building stone, and affords a fair article. The coal and also the other strata, for some distance above and below it, are well exposed in the bluff.

From this point, along the river and on the little runs that put into it, the coal has been more or less worked, until we reach sections 25 and 26, where the seam lies some twenty feet or more above the river. In section 26, on the level land and a little back from the river, several shafts have been sunk. One of the most westerly of these gave this section:

		Feet.	In.
1.	Soil and drift	20	
2.	"Second soil," black and very soft	10	
3.	Clay	4	
4.	Limestone	2 to 5	
5.	Sandstone	12	
6.	Clay shale	15	
7.	Limestone, containing much pyrite	1	8
8.	Black slate	1	6
9.	Coal	4 to 5	
10.	Clay	6	
11.	Sandstone, exposed	15	

A short distance to the east of this, and from about the same level, it was found necessary, in sinking a shaft, to go about thirty feet deeper in order to reach this seam. South of here, this coal is worked in section 23, township 12, range 6, when it appears in the bluff some eight or ten feet above the river. It is thinner here

than at the other mines in the county, and the overlying strata are in part different. A shaft, sunk a short distance from the river, penetrated strata as follows:

		Feet.	In.
1.	Clay	21	
2.	Clay shale	8	
3.	Limestone	1	
4.	Clay shale, with usually a little black slate at the bottom, and sometimes all slate	1	8
5.	Coal, with two inch clay parting	2	6
6.	Clay	not measured.	

"Horsebacks" are very common here, and, together with the thinness of the seam, render the working of this mine very expensive. The fact that there are no other mines in the vicinity, alone renders the working of this one profitable.

Coal No. 4 of the Illinois section, has been found at but one place, section 19, township 12, range 5, where the following section was obtained:

		Feet.	In.
1.	Limestone	3	
2.	Clay shale	10 to 12	
3.	Coal	4 to 6	
4.	Cannel coal, impure	½	10
5.	Clay	not measured.	

The cannel coal, No. 4 of this section, contains the remains of fishes and plants. Among the plants obtained here are *Pecopteris arborescens*, *P. areopteridius*, *P. acuta*, *P. chœrophylloides*, *Sphenophyllum Schlotheimii*, *Sphenopteris tenella*, *Pinnularia* —, *Selaginites* —, etc. Among the fish remains found was one nearly perfect fish belonging to the genus *Palæoniscus*; also, teeth, etc., of a *Diplodus*.

This cannel coal is seldom taken up with the main coal, and still less seldom is it brought to the mouth of the mine; hence, the amount of material from which I could collect was very small. Large quantities of a good article of coal are obtained from this mine.

The next seam below this appeared to be coal No. 2 of the Illinois section. From an exposure in the bluff of Walnut creek, section 17, township 12, range 5, this section was obtained:

		Feet.	In.
1.	Drift	not measured.	
2.	Clay and gravel stratified	3 to 5	
3.	Shale	45 to 50	
4.	Black slate	2 to 4	
5.	Coal	1	6
6.	Clay	not measured.	

This coal lies in the bed of the creek, and can be worked only at low water, most of it being covered at the time I was there. As this was the only place I examined, and no fossils were obtained here,

this seam is only provisionally referred to No. 2 of the general section. A similar seam is reported in section 17, township 12, range 6, at the foot of the bluffs, along Indian creek. This outcrop has not been worked to any extent.

The general dip of the Coal Measure strata in this region appears to be to the southeast, though not uniformly, but rather in undulations.

Coal No. 6 first appears in Stark county near its northern line, in township 14, range 6. Here it lies above the creek, and continues above it to the southern line of section 16. From here it is not exposed for several miles down the creek. At Modina, section 1, township 13, range 6, it lies considerably below the bed of the river. About a mile west of here it is some ten or more feet above Jack creek, a branch of Spoon river, and farther down this creek, and near its mouth, the coal lies but little above its bed. Farther south, and a little west, in the northern part of section 14, where it is again exposed, it lies some ten or twelve feet above the river. The exposures thus far have all been on the west bank. Half a mile south, and near the eastern line of the section, the coal appears some distance up the bluff, not less than twenty or twenty-five feet above the river. In the northwestern quarter of section 23, it is again exposed along a little run, and but a few feet above its bed. South of here, and near the eastern line of section 26, it crops out some twenty or thirty feet above the river. On the level upland, and but a short distance from the bluff, there are two shafts. The first one is about 50 feet deep, and the other one, which is but a few hundred feet to the east, is about 30 feet deeper, both working this same coal. South of this, I did not learn of an exposure for about five miles, when, in section 23, township 12, range 6, it again crops out some six or eight feet above the bed of the river. The course of Spoon river from here is to the southwest, and this coal seam does not, probably, again appear near the river. A statement of the workings and outcrops of coal No. 2 will be found in the report of Knox county.

Economical Geology.

Stone for Building Purposes.—Stark county is not very abundantly supplied with good material for these purposes. The supply is unevenly distributed, some parts being destitute, while in others there is plenty. There are but few valuable deposits of limestone in this county. In sections 21, 22, township 14, range 7, the most exten-

sive bed is exposed. It is from six to twelve feet thick, and furnishes considerable building stone, but the layers are thin, seldom exceeding four inches, and are very uneven. The stone is of a light-drab color, compact, even-textured, moderately hard, and is uninjured by the weather. The following section will show the position of this limestone to the underlying coals:

		Feet.	In.
1.	Limestone	6 to 12	
2.	Clay shale, not accurately measured, but supposed to be somewhere from	5 to 10	
3.	Limestone	4	
4.	Clay	4	6
5.	Clay shale	8	4
6.	Limestone	2	4
7.	Clay shale	9	10
8.	Coal		2
9.	Clay shale	12	
10.	Limestone		3
11.	Clay shale	8	
12.	Limestone		2
13.	Clay shale	4	5
14.	Coal No. 7 ?	2	7

The limestone, No. 1 of this section, is reported to make, when properly burned, an excellent lime for building purposes, being nearly equal to cement. For plastering it is not so good, being too dark-colored. For this and other information, I am indebted to A. B. Abbot, Esq., of Bradford.

Of sandstone, there are a number of outcrops that have been worked in this county. In section 16, township 14, range 6, there is a bed of this material which lies some ten or fifteen feet above coal No. 6. The stone is light-colored and quite soft. In section 14, township 13, range 6, there is a stratum of sandstone that lies a few feet below coal No. 6, and had furnished some building stone of fair quality. In township 12, range 6, section 14, a quarry has been opened which affords a harder stone, and is thought to be one of the best sandstone quarries in the county. West of this, in section 17, there is also a quarry which furnishes a fair article of building stone, and a dwelling house in this vicinity, which was erected quite a number of years ago, the material being taken from this quarry, is still uninjured. Another sandstone quarry was reported to have been opened on Walnut creek, in section 20, township 12, range 5.

Coal.—Stark county has an abundant supply of coal, which is at present derived mainly from coal No. 6. It crops out along West Fork, in Elmira township, and Spoon river, in Toulon, at intervals for about twenty miles, and can, probably, be found and worked along these streams and their tributaries for the whole distance. This coal varies in thickness from two and a half to six feet, seldom

reaching either extreme, but averaging from three and a half to five feet. Immense quantities of coal have been taken from this seam at its outcrops along the different streams. In Osceola township one shaft has been sunk near East Fork, and several others are partially completed. Shafts have also been sunk at Modina, and near Wyoming, in Toulon, and at Cox's mill, in Essex township.

The coal from this mine is generally good, and easily worked. At but two mines, as far as I learned, are "horsebacks," or slips, common. The clay band, which is usually from one to two feet above the base of the coal, and is called the "mining seam," is frequently taken advantage of by the miners, who remove it and then break down the coal from above. This seam is found throughout this coal in this region, and serves as a ready means for recognizing it, there being nothing in the other coal seams that corresponds with it.

This seam probably underlies townships 12, 13 and 14, range 7, and the eastern part of the same townships,, range 6.

Coal No. 4 (?) furnishes nearly all the rest of the coal used in this county, although but one mine is at present being worked in this seam, but the coal is from four to six feet thick and of fair quality, and the amount annually produced is large. This seam, probably, underlies the whole county, with, perhaps, the exception of a portion of township 12, ranges 5 and 6.

A coal, that is supposed to be No. 2, appears in the last named township, and has been worked a little. Coal No. 1, which lies some forty to seventy feet below No. 2, has not been reached in this county, but it seems probable that it underlies the whole of it. This seam is generally from three to six feet thick, and the coal is of fair quality.

Of the eight townships in Stark county, four of them (Osceola, Elmira, Toulon and West Jersey) furnish nearly all the present supply of coal, Essex furnishing but comparatively little, and Valley far less, and none is obtained from Penn and Goshen townships. As may readily be seen, the present yield is but a small fraction of what might have been annually obtained, were the demand sufficient to justify more extensive operations.

As yet, there is no railroad passing within the limits of the county, but two are talked of; one of them, the Peoria and Rock Island railroad, is to enter the county not far from the line between Valley and Essex, and runs north to near Wyoming, and from thence northwest through the city of Toulon, to Galva, in Henry county. The other, the Dixon, Peoria and Hannibal railroad, is to enter the county near the northeastern corner, and passes south to Bradford, and

from thence in a southwesterly direction to Princeville, Peoria county. Both of these roads will pass through more or less of the coal-field underlaid by No. 6, especially the one last named. It seems probable that anywhere in this county, along the proposed line of the Dixon, Peoria and Hannibal railroad, shafts may be sunk, and reach this upper seam at depths not exceeding one hundred and thirty feet. According to the miners' estimate, there are one million tons of coal to the square mile for every foot of thickness of the seam. Coal No. 6 is generally from four to five feet thick; but supposing that it will average only three feet, this will give over one hundred million tons of coal to either of the three eastern townships.

Timber, Soil and Agriculture.—Along the water-courses there is usually a variable belt of timber, consisting principally of the common varieties of oak, hickory, ash and maple, black walnut, butternut, cottonwood, sycamore, coffee-tree, buck-eye, box-elder, red-bud, wild-plum, cherry and crab-apple. The soil of these timbered lands is a clayey loam, sometimes resembling that of the prairie, though generally lighter colored and of less depth, but frequently partaking largely of the character of the subsoil, and of a dark-brown or yellowish color. Though much less fertile than the prairies, these lands are better adapted to the cultivation of fruit.

The soil of the prairies is a dark-colored loam, which contains a large percentage of humus. Its peculiar character is due to the admixture with the finely comminuted matter, which constituted the surface of the Drift, of the material resulting from the growth and decay, for long ages, of animal and vegetable substances upon its surface. If properly drained and cultivated, the prairies are everywhere productive. Drainage renders the soil dry enough for working earlier in the spring and later in the fall; makes it warmer at those periods, when warmth is most needed; helps, by admitting the atmosphere, to prepare the mineral food for the nourishment of the growing plants, and renders the latter less liable to injury from drouth.

CHAPTER XXXIII.

WOODFORD COUNTY.

Woodford county is bounded on the north by Marshall and LaSalle counties, on the east by Livingston and McLean, on the south by McLean and Tazewell, and on the west by the Illinois river. It is quite irregular in outline, and comprises a little over fifteen townships, or about five hundred and fifty-six square miles.

The most important stream in the county is the Mackinaw river, which intersects the southern part from northeast to southwest. To this Panther and Walnut creeks are tributary, the former rising in township 27, range 2 east, and the latter in township 27, range 1 west. The two forks unite in the southern part of township 27, range 1 east, and, running a little to the west of south, enter the Mackinaw in the southeastern part of township 26, range 1 west. Walnut creek rises in township 27, range 2 west, and empties into the Mackinaw about four miles below the mouth of Panther creek. In the northwestern part of the county are Richland and Partridge creeks, which rise, respectively, in townships 28 and 27, range 2 west, and empty into the Illinois in township 28, range 3 west. Only the southern and western portions of the county are even comparatively well watered by these streams, and there are but few springs within its limits. Good wells may generally be obtained at a depth of from fifteen to fifty feet, but in some cases much difficulty is experienced in finding water even at the latter depth.

The larger part of the county is prairie, and the surface is, for the most part, gently rolling. In the southern portion of the county the surface becomes more broken and hilly, and the prairies of much less extent, while in the western part, along the Illinois bluffs, and for some distance back, there is little or no prairie land, and the country is quite broken and intersected by deep ravines.

The soil of the prairies is a black loam, usually from one to three feet deep, and sometimes even more, with a yellow or brown clay subsoil. Timber originally skirted, for the most part, the ridges along the water-courses, and along the summits and steep slopes the subsoil comes near the surface, and the soil is usually of a lighter color. Much of the timber has been cut away since the first settlement of the county, and the process of denudation is continually going on.

The principal varieties of timber noticed on the level portions of the timbered lands were white, red, black and laurel oak and shell-bark and bitternut hickory; and along the slopes of the bluffs and in the valleys of the small streams there are, in addition to those above mentioned, sugar and white maple, box elder, black walnut, butternut, white and red elm, mulberry, wild cherry, sycamore, cottonwood, white and blue ash, hackberry and red-bud, with an undergrowth of sumac and hazel.

On the bottoms of the Illinois river we find white elm, willow, buckeye, black ash, cottonwood, and in the dryer portions the common varieties of oak and hickory, sycamore, and a few other kinds.

Surface Geology.

This comprises the usual subdivision of the Quaternary, Alluvium, Loess and Drift. The most extensive alluvial deposit in this county is on the western border, along the Illinois river. It extends from the north line of the county to Spring Bay, with an average width of about two miles. South of Partridge creek it becomes narrower, and gradually decreases in width, till at Spring Bay the bluff comes nearly to the river, leaving but a very narrow strip of bottom land. Along the river much of this land is wet, and only valuable, at present, for its timber, as it is subject to overflow at every considerable rise of the river. Occasionally there are low ridges that run nearly to the river, and here the land, together with that nearer the bluff, is valuable. The soil is a black, peaty loam, somewhat mixed with the sediment deposited at high water, and occasionally with fine gravel and sand. It is very fertile, and produces large crops when sufficiently raised above the river.

Along the valleys of the small water-courses there are generally some alluvial deposits, but they are quite limited in extent, seldom exceeding a few rods in width. The soil is a dark-colored loam, intermingled with sand and gravel.

Loess.—In township 28, range 2 west, on Richland creek, a deposit of sandy clay was found which contained fresh-water shells, probably of existing species, but this bed appeared to underlie the yellow clays of the Drift, and will be noticed under that head. It is probable that the Loess caps the bluff of the Illinois, at least in places, but no point was observed where it could be identified with certainty.

Drift.—The entire surface of the uplands of the county are covered by accumulations of this age, which attain a thickness of from fifty to one hundred and twenty-five feet. These deposits comprise a series of yellow, brown and blue clays, sand and gravel. At Minonk, township 28, range 2 east, a shaft has been sunk, from which the following section of the Drift was obtained:

	Feet.
1. Soil	2
2. Yellow clay	14
3. Blue clay	18
4. Sand and gravel	15
5. Cemented sand and gravel	76
	125

In section 21, township 28, range 2 west, the Drift exposed in the ravine of Richland creek presented a different order of arrangement. A section here showed:

	Feet.	In.
1. Soil and yellow clay	not measured.	
2. Purplish clay or hard-pan	not measured.	
3. Blue sandy clay, containing fresh-water shells	6	
4. Rotten drift-wood, or peaty matter	3	6
5. Blue clay	3 to 4	
6. Drift-wood, or peaty matter	5 to 6	
7. Blue clay	not measured.	

In this vicinity, on the uplands, wells are reported to have been sunk to a depth of from fifty to sixty feet, and the hard-pan or purple clay not reached. Judging from the height of the bluff, I should think that Nos. 1 and 2 of the last section would probably exceed these figures.

No. 3 containing fragments of fresh-water shells, among which the genera *Succinea* and *Lymnea* were recognized by Mr. MEEK. This bed resembles the Loess, but its position, below a considerable portion of the Drift, shows that it belongs to an older formation.

No. 4 resembles peat and contains fragments of wood, some of which are well enough preserved to be recognized, but the larger portion has been converted into peaty matter. Among the specimens collected from this bed, the following kinds of timber were recognized by Prof. LESQUEREUX: American white birch, black or double spruce, American larch or Tamarack, and one variety of cedar.

No. 5 resembles No. 3, but no shells were noticed in it.

No. 6 is similar in character to No. 4. This bed was not as well exposed as the upper one, but was examined by boring through it. Of course but small specimens could be secured by this method, and the only kind of wood thus obtained, that could be recognized, was the American or Black larch.

These beds appear to have been formed mainly of drift-wood, the larger part of which has undergone a partial decomposition. There is too large a percentage of earthy material intermingled with the peaty matter to be valuable for fuel. It might, however, be used as a fertilizer, and where it crops out so as to be readily obtainable may prove of value. The material of both beds has the odor of well decayed manure.*

No. 7 resembles the ordinary blue clays of the Drift period. I am indebted to Mr. Wm. Rice, who resides in the neighborhood, for assistance in examining these beds. The peaty layers have been examined for some distance by him.

A bed of light-colored sand, of considerable extent and thickness, is reported to lie in the Illinois bluffs in the northern part of township 28, range 3 west. It is said to be too fine to make good mortar, and may prove valuable for glass-making.

Boulders of various kinds, and varying from a few inches to several feet in diameter, are found in the Drift. They consist of granite, syenite, porphyry, trap, horn-blende, quartz, limestone, etc., and occasionally a specimen of native copper.

Coal Measures.—All the stratified rocks exposed in Woodford county belong to the Coal Measures, and they crop out in but very few places. In section 1, township 27, range 3 west, about four miles northwest of Metamora, some beds of limestone are exposed for a short distance on Partridge creek. The upper layer is a compact rock, and makes a good building material, but only about three feet in thickness of this was to be seen. The only fossils I obtained from it were: *Productus longispinus* and *Athyris subtilita*. The lower rock is of poorer quality, and breaks badly on being quarried. From this I obtained a large *Aviculopecten*, species not known.

Near to this a shaft has been sunk over one hundred and thirty feet, and a boring was made nearly eighty feet further. The shaft is located at

*These beds are undoubtedly the equivalent of similar strata passed through in the shafts at Bloomington, at a depth of about two hundred to two hundred and fifty feet below the surface, and being entirely below the true boulder clay, or Drift proper. They may be considered as stratified Post Tertiary deposits, representing the ancient soils and conditions that obtained anterior to the Drift epoch. A. H. W.

the foot of the bluff, which is some sixty or eighty feet high. The rocks penetrated gave the following section:

		Feet.	In.
1.	Drift	5	6
2.	Clay shale	19	
3.	Sandstone	6	
4.	Clay shale	4	
5.	Sandstone	7	6
6.	Clay shale	4	6
7.	Sandstone	1	
8.	Slate	1	
9.	Coal	1	
10.	Clay shale	56	
11.	Sandstone	15	
12.	Coal		3
13.	Sandstone	5	
14.	Coal	3	6
15.	Clay shale	5	4
16.	Sandstone	4	2
17.	Clay shale	5	
18.	Limestone and chert	1	1
19.	Black slate	6	2
20.	Clay shale	14	7
21.	Sandstone, fine-grained	31	
22.	Black slate	4	8
23.	Coal		10
24.	Clay shale	6	1
25.	Sandstone	?	
		212	2

No. 14 is the coal seam worked at this shaft. The larger part of it furnishes a very poor quality of coal, there being only about nine inches near the middle of the seam that is good. The lower part of it contains considerable pyrites, the "sulphur" of the miners, but by mixing the good with the poor, the whole is made saleable. As the expense of mining this coal is considerable, a high. price has to be charged for it, and at present there are no other coal mines nearer Metamora than those opposite to Peoria, in Tazewell county. Should another shaft, furnishing better coal, be opened in the vicinity, the working of this would have to be abandoned.

The fossils found in connection with this seam are: *Chonetes mesoloba*, and *Rhynchonella Uta*. These are abundant, and fragments of others were noticed.

The journal of the shaft was obtained for this report by Dr. J. M. Clark, of Metamora. A boring was made from No. 14 to No. 25, to learn if a better seam could not be found. This part of the section was furnished me by the foreman, Mr. Aiken.

Coal has been mined in but one other place in the county, which is at Minonk. This place is located on nearly the highest land in the county, and the shaft was sunk on the prairie, near the rail-

road, and about on a level with the town. The most of the following section was furnished me by the Superintendent, Mr. Atherton, and the remainder by D. C. Taft, Esq.:

	Feet.	In
1. Drift	125	
2. Limestone	6	
3. Clay shale	3	
4. Black slate	1	
5. Blue clay shale	7	
6. Red clay shale	3	
7. Limestone	1	
8. Clay shale	18	
9. Limestone	1	
10. Sandstone	14	
11. Clay shale	10	
12. Arenaceous shale	7	
13. Black slate	3	
14. Blue clay shale	9	
15. Red clay shale	13	
16. Sandstone	100	
17. Black slate	3	
18. Clay shale	2	
19. Coal	3	
20. Clay	12	
21. Arenaceous shale	6	
22. Argillaceous limestone	2	
23. Arenaceous shale	30	
24. Coal		2
25. Clay	6	
26. Arenaceous shale	33	
27. Black slate	19	
28. Sandstone	12	
29. Limestone	2	
30. Clay shale	18	
31. Limestone	2	
32. Sandstone	6	
33. Clay shale	18	
34. Chert		9
35. Clay shale	18	
36. Black slate	2	
37. Clay shale	14	
38. Sulphur rock	1	
39. Black slate	5	
40. Clay shale 41. Black slate	7	
42. Coal	3	10
	546	9

As the shaft had been sunk sometime before I visited it, much of the material taken out was covered up, and many of the fossils had been carried away. Crinoidal stems were abundant in some of the upper beds, but the exact horizon from which they came I did not learn.

No. 2.—This is the thickest bed of limestone that was found in sinking the shaft. In it were *Productus longispinus*, *P. Prattenianus*, *Athyris subtilita*, and *Platyostoma Peoriensis*.

No. 7 contained *Productus longispinus*, *Syntrielasma hemiplicata*, and a coral, probably a *Cyathaxonia*.

No. 19.—This coal corresponds with that worked at the Metamora shaft, No. 14 of that section, and like that, the upper and lower portions are impure, only about nine inches of the middle being good. After working this seam for a short time it was abandoned, being unable to compete in the market with the superior Vermilion coal brought here by the railroad. This seam is, probably, No. 6 of the Illinois section. A boring having been made to No. 27, and a portion of it mistaken for coal, the shaft was sunk through it into No. 28.

No. 22.—This is the only limestone penetrated by the shaft below the coal. Only a small piece of this limestone was obtained, but in it we recognized two species of *Productus*, and a *Chonetes*. The remainder of the section, from No. 28, was obtained from the journal of a boring.

No. 24 is probably the representative of coal No. 5 of the Illinois section, though this is by no means certain. No. 38 was called by the miners "Sulphur rock." I was unable to learn anything further about it.

No. 42, *Coal.*—This is supposed to be coal No. 2 of the Illinois section, and corresponds with the lower LaSalle coal. This has only been reached by boring. Work has ceased at this shaft for the present, but it is reported that it is to be resumed hereafter.

Economical Geology.

Stone for Building.—The supply of this material is very limited, there being but very few outcrops of rock within the limits of the county. Southwest of Secor, in sections 23 and 24, township 26, range 1 west, there is an outcrop of limestone. The lower part of the quarry was filled with water, so that I was unable to learn upon what the limestone rests, or how thick it is, but it appears somewhere from eight to twelve feet. It is of a bluish-gray color, streaked with white, and, for the most part, compact. It appears to have been at one time cellular, and the white portions have resulted from the infiltration of colorless carbonate of lime. In some portions of the strata the cavities still remain, and are coated with crystals of calcite, with, occasionally, pyrites.

The rock contains a few fossils, among the most common of which are the following: *Productus longispinus*, *Athyris subtilita*, and *Cyathaxonia proliferum*. The quarries furnish a considerable quantity of good building stone, which, from its scarcity in this vicinity, is quite valuable. The rock makes good lime, and the fragments from the quarries might be utilized in this way.

South of Versailles, in section 33 of this township, there is another quarry, the rock from which is reported to be similar to that above mentioned. Some small exposures of limestone are reported along the Mackinaw river, but whether in Woodford county or beyond its limits, I did not learn. There is an outcrop of limestone a few miles northwest of Metamora, in section 1, township 27, range 3 west. This exposure has been described in the preceding pages.

Coal.—The supply of this important mineral is quite limited. The only mine that is worked at present is the one northeast of Metamora, in section 1, township 27, range 3 west. The seam worked here is probably coal No. 6 of the Illinois Valley section. So far, this coal has been tested at two places in this county, and at each it is from three to three and a half feet thick and there is a band about nine inches thick near the middle of the seam, that furnishes an excellent quality of coal, while that above and below is very poor. A boring was made from the bottom of this shaft, to see if a more valuable coal could not be found. Coal No. 4 (?) was struck about seventy feet below, but it was only ten inches thick. The next seam, if No. 3 is absent here, would be No. 2, and probably lies about one hundred and fifty feet below this.

This lower coal, No. 2, has been reached, at Minonk, by sinking a shaft about four hundred and forty feet, and boring about one hundred feet farther. The coal was found to be three feet ten inches in thickness. This seam probably underlies the whole county at a depth of from three hundred to five hundred and fifty feet. Elsewhere, coal No. 4, numbered 24 in the section of the Minonk shaft, may be thick enough to be of some value. In the La Salle section, reported by Mr. H. C. Freeman, this seam is from three to six feet thick.

Though coal cannot be obtained in this county except by means of shafts sunk to a considerable depth, still it can be furnished from abroad to those along the line of the railroads, at reasonable rates, and hence deep mining has not been largely undertaken.

Soil and Agricultural Products.—The soil of the prairie is usually of a black or dark-brown color, and from one to three or more feet deep. Its dark color shows it to be largely composed of humus,

which has resulted from the growth and decay of vegetable and animal matter upon the surface for long ages. This admixture of organic matter with the finely pulverized mineral matter which constituted the upper surface of the Drift when it emerged from the waters in which it had accumulated, was necessary in order to form the fertile soil which now constitutes the surface of our prairie lands. The brown clays, which lie immediately below this vegetable mould, and form the subsoil, do not readily absorb the excess of moisture which filters through the soil, and hence the surface is frequently rendered too wet where it is level or but slightly rolling, as is the case over a considerable portion of this county, to be successfully cultivated without artificial draining. It is true that, by waiting a little later in the spring, the soil can then be worked, but that gives so much the less time for the crop to ripen, and if the frost comes early, it is likely to be injured, if not entirely lost. By proper drainage, this would be, in a large measure, remedied, the soil made warmer and more productive, and the growing season rendered somewhat longer. In most places there is sufficient descent towards the streams so that drains can be made with but little difficulty. Frequently, the partial or entire saving of a crop would result from a thorough drainage of the surface. Wheat, corn and hay are the principal products of the prairie, but other grains and fruits, adapted to the climate, may be grown with more or less success.

In the vicinity of the water-courses, the land is more rolling and hilly, and the subsoil comes nearer the surface, and a portion of the humus has been washed out of the soil, leaving it much less fertile, but better adapted to some kind of crops, particularly fruits. For ordinary purposes these soils require little or no draining. In their uncultivated state they produce good timber,—the common varieties of oak, hickory, elm and ash, sugar and white maple, wild cherry, black walnut, butternut and hackberry.

Along the Illinois river bluffs grape vines are very abundant, more so than I noticed elsewhere. I saw but few vineyards in the portions visited, but the abundance and luxuriance of the wild vines would seem to indicate that here is a favored locality for the culture of the grape. Along these bluffs but little draining would be necessary, though in most places where the grape has been successfully cultivated, it has usually been found to pay to underdrain, even where the soil appeared, to the unpracticed eye, dry enough.

Underdrains are profitable, not only to carry off the surplus moisture, but also to give the atmosphere a chance to act more readily and

thoroughly upon the subsoil. This action is necessary to assist in dissolving and preparing the mineral food for the vine, which sends its roots deep into the surrounding soil for this very nourishment.

The finest apple orchards in the county are found on these "barrens," and most other kinds of fruit succeed best on this kind of soil.

INDEX

PAGE

Adams county, geology of..... 284
Adams county, Quaternary system of.. 285
Adams county, Coal Measures in..... 289
Adams county, St. Louis limestone in.. 293
Adams county, Keokuk limestone in.... 296
Adams county, Burlington limestone in 298
Adams county, Kinderhook group in.... 300
Adams county, economical geology of.. 301
Adams county, soil and timber in..... 304
Agricultural resources....21, 101, 123, 178, 261, 304, 318, 357, 376, 555, 582, 605, 613
Alluvial bottoms.....21, 26, 46, 59, 104, 155, 275, 307, 321, 338, 451, 500, 503, 506
Artesian wells.....186, 200, 234, 449, 466, 499
Athens quarries..... 184, 195
Austin's coal..... 29

Barker's coal, analysis of.....68, 369
Bassett's coal.....48, 292
Bitumens..... 199
Black Diamond mine..... 7
Black slate.....37, 107, 445
Blanchard's coal..... 50
Bloom village, exposure at..... 157
Breese coal mine..... 163
Bridgeport limestone..... 191
Brown county, geology of..... 306
Brown county, Quaternary system in... 306
Brown county, Coal Measures in..... 310
Brown county, St. Louis limestone in... 313
Brown county, Keokuk group in..... 314
Brown county, economical geology of.. 315
Brown county, soil and agriculture in.. 318
Building stone, 20, 42, 57, 70, 101, 123, 155, 178, 197, 232, 256, 278, 302, 355, 374, 386, 401, 418, 433, 499, 527, 568, 578, 594, 602, 612
Burlington limestone.....34, 53, 66, 249, 268 298, 552, 567

Calciferous sandstone.....207, 229
Calhoun county, geology of..... 237
Calhoun county, St. Peters sandstone in 240
Calhoun county, Trenton group in..... 240
Calhoun county, Cincinnati group in... 242
Calhoun county, Niagara group in..... 243
Calhoun county, Hamilton group in..... 245

PAGE

Calhoun county, Kinderhook group in.. 247
Calhoun county, Burlington limestone in 249
Calhoun county, Keokuk group in..... 252
Calhoun county, St. Louis group in..... 253
Calhoun county, Coal Measures in..... 253
Calhoun county, Quaternary system in. 255
Calhoun county, economical geology of 256
Calhoun county, soil and agriculture of. 261
Cannel coal.....354, 601
Cass and Menard counties, geology of.. 420
Cass and Menard counties, Coal Measures in..... 422
Cass and Menard counties, economical geology of..... 431
Cap au Gres fault..... 238
Cement.....41, 198, 230, 233
Central City, section near..... 119
Centralia boring, section of..... 138
Champaign county, see Edgar, Ford and 533
Chester group..... 31
Chicago artesian well, section of..... 186
Cincinnati group..39, 242, 372, 385, 394, 461, 478, 495
Cincinnati group fossils.....394, 461, 480
Clays.....21, 41, 55, 68, 198, 303, 316, 354
Clay for brick....303, 316, 333, 335, 386, 418, 434, 449, 528
Clinton county, geology of..... 103
Clinton county, geological formation of. 105
Clinton county, Upper Sandstone in. ... 106
Clinton county, Lower Sandstone in.... 107
Clinton county, economical geology of.. 120
Coal, analyses of.....274, 292, 301, 332, 352, 353
Coal No. 1.....28, 47, 61, 290, 328, 343, 442
Coal No. 2.....28, 47, 61, 290, 310, 328, 343, 471, 495, 510, 559, 568
Coal No. 3....47, 290, 326, 328, 411, 510, 573, 593, 595
Coal No. 4.....347, 348, 510, 601
Coal No. 5.....6, 28, 47, 326, 346, 348, 425, 535
Coal No. 6.....6, 28, 348, 509, 518, 599, 602
Coal No. 7.....6, 350, 425, 509, 517, 541, 598
Coal No. 8..... 6
Coal No. 10..... 509
Coal No. 11.....425, 509
Coal No. 12..... 509
Coal mining estimates.....19, 482, 526

PAGE

Coal shaft at Jacksonville..... 415
Coal shaft at Bloomington..... 445
Coal shaft at Braidwood..... 487
Coal shaft at Martin's, Mercer county... 573
Coal shaft at Bradford, Stark county... 599
Coal shaft, S. C. Francis', Stark county. 598, 599
Coal shaft, Metamora.....611, 618
Coal shaft, Minonk..... 611
Coal shaft, Cuba.....353, 348
Cook county, geology of..... 180
Cook county, surface geology..... 181
Cook county, modified drift in..... 183
Cook county, Niagara group in..... 187
Cook county, Drift deposits in..... 184
Cook county, economical geology of... 197
Cook county, lime and cement beds in.. 198
Cook county, peat deposits of..... 198
Cook county, bitumens of..... 199
Cook county, minerals of..... 200
Copper..... 486
Copperas..... 449
Covell's quarry..... 194

DeKalb, Kane and DuPage counties, geology of..... 361
DeKalb, Kane and DuPage counties, artesian wells in..... 364
DeKalb, Kane and DuPage counties, Niagara group in..... 364
DeKalb, Kane and DuPage counties, Cincinnati group in..... 372
DeKalb, Kane and DuPage counties, Trenton group in..... 374
DeKalb, Kane and DuPage counties, economical geology of..... 374
Drift, section of.....4, 47, 129, 208, 255, 277, 288, 308, 322, 338, 363, 381, 390, 402, 421, 437, 455, 490, 507, 558, 572, 585, 598, 607
Drift, "Blue mud" in..... 4
DuPage county; see DeKalb, Kane, etc. 361
DuQuoin central mine, character of..... 18
DuQuoin central mine, section of..... 12
DuQuoin mine, section of..... 12
DuQuoin mine, fossils of..... 14

Eagle shaft, coals of.....7, 215, 487
Eagle shaft, section of.....7, 217
Edgar, Ford and Champaign counties, section of rocks in..... 535
geology of..... 533
Exeter mine..... 68

Fire clay.....232, 528
Ford county; see Edgar, Ford, etc..... 533
Frosts' mine..... 68
Fulton county, geology of..... 337
Fulton county, Coal Measures in..... 341
Fulton county, conglomerate in..... 351
Fulton county, St. Louis limestone in... 351
Fulton county, economical geology of.. 352
Fulton county, list of trees in..... 353

PAGE

Galena limestone.....386, 391
Galena and native copper.....20, 529
Gas wells.....234, 467
Glass sand.....233, 258
Gold..... 529
Greene county, geology of..... 45
Greene county, general section of..... 46
Greene county, Quaternary deposits in. 46
Greene county, Coal Measure section in 47
Greene county, St. Louis limestone in.. 51
Greene county, Keokuk limestone in... 52
Greene county, Burlington limestone in 53
Greene county, Kinderhook group in... 54
Greene county, economical geology of.. 54
Grundy county, geology of..... 450
Grundy county, Post Tertiary beds in.. 451
Grundy county, Coal Measures in..... 455
Grundy county, Cincinnati group in.... 460
Grundy county, Trenton limestone in... 461
Grundy county, St. Peters sandstone in. 462
Grundy county, economical geology of. 462
Grundy county, artesian wells in..... 466

Hamilton group..... 245
Harrison's quarry..... 193
Henderson county, geology of..... 543
Henderson county, Coal Measures in... 545
Henderson county, Keokuk group in.... 546
Henderson county, Burlington limestone in 547
Henderson county, Kinderhook group in 552
Henderson county, economical geology of 553
Hodges' creek, coal of..... 54
Horse creek, exposures on..... 170
Hydraulic limestone.....56, 69, 281, 466
Hydraulic cement 233

Iron ore....20, 43, 57, 69, 123, 154, 164, 259, 281, 333, 354, 432, 466, 486, 499, 529, 555, 582
Iron ore, analyses of..... 334
Iroquois county; see Kankakee and Iroquois..... 489

Jefferson county, geology of..... 157
Jefferson county, economical geology of 175
Jefferson county, mineral waters of 177
Jersey county, geology of..... 24
Jersey county, section of strata in..... 25
Jersey county, Quaternary system in .. 26
Jersey county, Coal Measures in..... 28
Jersey county, St. Louis group in..... 32
Jersey county, Keokuk group in 34
Jersey county, Burlington limestone of, 34
Jersey county, Kinderhook group in.... 36
Jersey county, Black slate of 37
Jersey county, Hamilton group of 38
Jersey county, Niagara limestone in.... 38
Jersey county, Cincinnati group in 39
Jersey county, Trenton limestone in.... 40
Jersey county, economical geology of.. 40
Jersey county, soil and timber in 43

PAGE

Kane county; see DeKalb, Kane and DuPage 361
Kankakee and Iroquois counties, geology of 489
Kankakee and Iroquois counties, Drift in 491, 492
Kankakee and Iroquois counties, Coal Measures in 494, 502
Kankakee and Iroquois counties, Niagara limestone in 495
Kankakee and Iroquois counties, Cincinnati group in 497
Kankakee and Iroquois counties, economical geology of 498, 503
Kankakee and Iroquois counties, ancient valley in 503
Kendall county, geology of 389
Kendall county, Coal Measures in 391
Kendall county, Niagara group in 392
Kendall county, Cincinnati group in 395
Kendall county, Trenton limestone in .. 397
Kendall county, St. Peters sandstone in, 400
Kendall county, economical geology of, 401
Keokuk group 34, 52, 66, 252, 271, 296, 314, 331, 546
Keokuk group, fossils of 34, 52, 66, 297, 331, 547
Kinderhook group .. 36, 51, 247, 266, 300, 552, 567, 577
Kinderhook group, fossils in 37, 248, 266
Knox county, geology of 584
Knox county, Coal Measures in 585
Knox county, economical geology of ... 595

Lake county; see McHenry and Lake counties 378
Lake tunnel, peculiar features of 185
Langley's coal 30
LaSalle county, geology of 202
LaSalle county, scenery of 204
LaSalle county, timber of 205
LaSalle county, geological formations of 206
LaSalle county, river section of 207
LaSalle county, Drift deposits in 208
LaSalle county, Coal Measure section in 210
LaSalle county, fossils of 212
LaSalle county, coal area of 218
LaSalle county, middle coal of 220
LaSalle county, upper coal of 221
LaSalle county, coals, quality of 222
LaSalle county, Trenton limestone in .. 223
LaSalle county, Trenton limestones, fossils of 227
LaSalle county, St. Peters sandstone in, 227
LaSalle county, Calciferous beds in 229
LaSalle county, economical geology of, 231
LaSalle county, mineral springs in 232
LaSalle county, gas wells in 234
LaSalle county, artesian wells in 234
Limestone for lime .. 57, 69, 232, 258, 281, 303, 316, 335, 356, 375, 402, 554, 569, 579, 595

PAGE

Loess 26, 46, 61, 256, 276, 287, 308, 322, 339, 405, 421, 437, 506, 572, 585, 607
Logan county; see Tazewell, Logan, McLean, etc 435
Long's quarry, LaSalle county 224
Lower sandstone formation 76, 107
Lyons, outcrop at 191

Marble 281
Marsailles, outcrop at 219
Marion county, geology of 126
Marion county, geological formations of 127
Marion county, economical geology of, 153
Marion county iron ores in 154
Marion county, coal localities in 153
Marion county, timber and agriculture of 155
Mason county; see Tazewell, McLean, Logan, etc 435
McHenry and Lake counties, geology of 378
McHenry and Lake counties, Drift deposits in 381
McHenry and Lake counties, Niagara group in 384
McHenry and Lake counties, Cincinnati group in 385
McHenry and Lake counties, economical geology of 386
McLean county; see Tazewell, McLean, Logan, etc 435
Menard county; see Cass and Menard counties 420
Mercer county, geology of 571
Mercer county, Loess and Drift in 572
Mercer county, Coal Measures in 573
Mercer county, Kinderhook group in ... 577
Mercer county, economical geology of, 578
Mercer county, soil and agriculture of, 582
Miller's lime kiln 188
Mill shaft at DuQuoin, section of 12
Minerals 101, 123, 177, 200, 232, 259, 281, 555
Moore's coal, or Frost's mine, analysis of 68
Moore's coal, section of 62, 64
Morgan county, geology of 404
Morgan county, Coal Measures in 406
Morgan county, St. Louis limestone in, 416
Morgan county, economical geology of, 417

Nashville shaft, section of 91
Niagara group, 38, 187, 243, 265, 364, 384, 392, 475, 495
Niagara group, fossils in 193, 366, 393
Nettle's coal 47, 49

Oil wells 481

Peat, deposits of ... 198, 233, 376, 387, 402, 486, 499
Perry county, geology of 1
Perry county, Coal Measures 2
Perry county, economical geology of ... 16
Perry county, building materials in 20

PAGE

Perry county, iron ores in 20
Perry county, agricultural resources of, 21
Pike county, geology of 263
Pike county, Niagara limestone in..... 265
Pike county, Kinderhook group in..... 266
Pike county, Burlington limestone in .. 268
Pike county, Keokuk group in..... 271
Pike county, St. Louis group in 272
Pike county, Coal Measures in 272
Pike county, Quaternary system in..... 275
Pike county, economical geology of.... 278
Post-oak flats 2, 22
Pot-holes in limestone 182, 195
Potter's clay.....55, 281, 303, 316, 333, 465, 484
Paint-clay 55
Price's coal mine..... 174

Quick-lime..... 41

Richview shaft, section of..... 75

Salt 154, 261
Salt Springs 261
Schuyler county, geology of..... 320
Schuyler county, Quaternary system in, 321
Schuyler county, Coal Measures in..... 322
Schuyler county, St. Louis group in 330
Schuyler county, Keokuk group in..... 331
Schuyler county, economical geology of 331
Scott county, geology of 59
Scott county, section of rocks in 61
Scott county, Coal Measures of..... 61
Scott county, St. Louis group in..... 64
Scott county, Keokuk group in..... 66
Scott county, Burlington group in 66
Scott county, economical geology in.... 67
Scott county, Potter's clay in..... 68
Scott county, Hydraulic limestone in... 69
Shelton's coal mine..... 173
Shoal Creek limestone.....76, 88, 106, 158
Slaty Division of Clinton county..... 107
Soil and timber.....43, 261, 282, 304, 318, 358, 555
Springs, mineral...176, 233, 282, 318, 335, 402, 449
Springs, Perry..... 282
Springs, Versailles..... 318
Stark county, geology of..... 597
Stark county, Quaternary deposits in... 598
Stark county, Coal Measures in. 598
Stark county, economical geology of... 602
Stark county, soil and agriculture of.... 605
St. John's shaft, section of..... 12
St. Louis group...32, 51, 64, 253, 272, 293, 313, 330, 351, 546
St. Louis group fossils.....64, 295, 331
St. Peters sandstone.....207, 227, 240, 400, 461
Streator coal, section of..... 217

Tazewell, McLean, Logan and Mason counties, geology of..... 435

PAGE

Tazewell, McLean, Logan and Mason counties, boundaries of..... 435
Tazewell, McLean, Logan and Mason counties, geological formations in.... 436
Tazewell, McLean, Logan and Mason counties, Drift section of..... 437
Tazewell, McLean, Logan and Mason counties, Coal Measures in..... 439
Tazewell, McLean, Logan and Mason counties, economical geology of..... 446
Thornton quarries..... 188
Trenton group.....223, 240, 397, 461
Trenton group fossils.....227, 241, 398, 461
Trenton coal shaft, section of..... 110
Tulison's coal.....47, 49

Upper sandstone formation.....94, 106

Vermilion county, geology of..... 505
Vermilion county, Loess in..... 506
Vermilion county, Drift in..... 507
Vermilion county, Coal Measures in.... 509
Vermilion county, economical geology of 521
Versailles Springs, analyses of water.. 318

Wall's colliery, section of..... 12
Warren county, geology of..... 557
Warren county, Coal Measures in..... 558
Warren county, Burlington limestone in..... 564
Warren county, Kinderhook group in... 567
Warren county, economical geology of, 568
Washington county, geology of..... 72
Washington county, formations in..... 75
Washington county, section of rocks in, 75
Washington county, Upper Sandstone group..... 75
Washington county, economical geology of..... 99
Wells, gas and artesian...186, 234, 449, 457, 482, 487
Will county, geology of..... 468
Will county, Quaternary beds in..... 469
Will county, Coal Measures in..... 470
Will county, Niagara limestone in..... 475
Will county, Cincinnati group in..... 478
Will county, general section of beds in. 481
Will county, economical geology of..... 481
Will county, comparison of levels in.... 487
Wilkey's coal mine..... 174
Williamson's coal, section of..... 29
Woodford county, geology of..... 606
Woodford county, Loess and Drift in... 608
Woodford county, Coal Measures in.... 609
Woodford county, economical geology of..... 612
Woodford county, building stone..... 612
Woodford county, soil and agriculture of 613

Zinc blende..... 529

BOUND BY
HM

UNIVERSITY OF ILLINOIS-URBANA
557IL6E C002 V002
ECONOMICAL GEOLOGY OF ILLINOIS SPRINGFI
3 0112 025311785